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REGIONAL ANATOMY

VOLUME I.



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REGIONAL ANATOMY

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UNIVERSITY OF ABERDEEN, AND TO THE ROYAL COLLEGE OF
SURGEONS, EDINBURGH; AND FORMERLY EXAMINER IN
ANATOMY TO THE UNIVERSITY OF ST. ANDREWS

VOLUME I

THE UPPER AND LOWER LIMBS

NEW AND REVISED EDITION

EDINBURGH

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PREFACE

THE first edition of the Author's *Essentials of Regional Anatomy* having been exhausted within two years of its publication, the opportunity afforded has been utilised to produce what is, to all intents, a new work.

In the present edition much has been added and even more has been re-written, and as it is to be completed by the issue of subsequent volumes dealing with the central nervous system, the joints and special senses, it is hoped that the completed work will prove a reliable introduction to the science of Human Anatomy.

As the present issue, like its predecessor, is primarily intended for the use of senior students of Anatomy, the customary guides to the dissector are omitted, but at the same time the arrangement of the structures described is, in the majority of instances, that in which they should be dissected.

The absence of illustrations will probably detract from the appearance of the work, and may even be regarded by some as a positive defect, but in actual practice the system which compels the student to furnish his own illustrations has been found to work so successfully, and has been acknowledged by those most immediately affected to be of such high educational value, that the Author sees no reason to depart from a procedure which has been proved to work most successfully.

In the preparation of the whole work, but particularly in the volume dealing with the Abdomen and Thorax, the greatest care has been taken to ensure that the descriptions shall comply with the results of recently published work

by Addison, Birmingham, Carmichael, Cunningham, Keith, Symington, Testut, and others; nor has the Author refrained from utilising his own abdominal observations, both published and unpublished. Whilst the text may not therefore always harmonise with preconceived, and possibly erroneous views, it crystallises the results of much modern anatomical research. As a minor detail, it may also be mentioned that the descriptions apply to the erect attitude, a point too apt to be overlooked in Descriptive Anatomy.

In such a work, dealing as it does with a multiplicity of facts, it is very difficult, if not actually impossible, to eliminate all typographical errors. Much care has, however, been devoted to the proof sheets, and the Author desires to acknowledge very cordially the valuable assistance he has received in this connection from Professor Addison, for the revision of that portion of the text which deals with his recently published abdominal work; to Mr. Scott Carmichael, F.R.C.S.E., for revising the paragraphs upon the Gall-bladder, and also for much valuable assistance with the revision of the manuscripts and the proof sheets; and to Drs. James Cameron and Alex. McIntosh, for the care and attention which they have given to the reading of the proof sheets. Nor must the valuable suggestions made from time to time by the members of the Author's practical class of Anatomy be forgotten, for they have been of very real service in the preparation of the present edition.

THE NEW SCHOOL,
September 1902.

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THE UPPER EXTREMITY

A STUDY of the upper extremity comprises an examination of the following regions:—

1. The dissection of the back with reference to the upper extremity.
2. The pectoral region and axilla.
3. The shoulder and scapular region.
4. The antecubital fossa.
5. The front of the upper arm.
6. The back of the upper arm.
7. The superficial dissection of the front of the forearm.
8. The deep dissection of the front of the forearm.
9. The palm of the hand.
10. The back of the forearm.
11. The dorsal aspect of the wrist and hand.

I. THE DISSECTION OF THE BACK WITH REFERENCE TO THE UPPER EXTREMITY

The Cutaneous Nerves of the Back.—All the cutaneous nerves of the back are derived from the posterior primary divisions of a spinal nerve.

There are in all thirty-one pairs of spinal nerves; they are named from the various regions in which they are found. Thus there are—

- 8 cervical nerves.
- 12 dorsal nerves.
- 5 lumbar nerves.
- 5 sacral nerves.
- 1 coccygeal nerve.

Making in all a total of 31 pairs of spinal nerves.

Each spinal nerve springs from the spinal cord by

two roots, an *anterior or motor root*, and a *posterior or sensory root*, the latter having a ganglion upon it. These two roots unite, and a spinal nerve is formed. This emerges from the spinal column through an intervertebral foramen, and immediately divides into an anterior and a posterior primary division.

The *anterior primary division* of a spinal nerve in the dorsal region gives off, midway between the spines of the vertebræ and the sternum, a lateral cutaneous branch, and eventually ends as an anterior cutaneous nerve.

In all the other regions the anterior primary divisions of the spinal nerves form plexuses—as, the cervical, brachial, lumbar, sacral, and sacro-coccygeal plexuses.

The *posterior primary divisions* of all the spinal nerves supply the post-axial structures, that is, the various structures which lie behind the vertebral column. They divide into two branches, inner and outer. Down to the level of the sixth dorsal vertebra the inner branch supplies the skin and the outer branch muscles. Below that level this is reversed.

The Posterior Primary Divisions of the Spinal Nerves.

—It is a matter of convenience to discuss the posterior primary divisions of all the spinal nerves together, as by so doing a clearer perception of the whole question is obtained.

Cervical Nerves.—The posterior primary division of *the first cervical or suboccipital nerve* does not divide into inner and outer branches, and is purely muscular.

The internal branch from the posterior primary division of *the second cervical nerve* is termed, from its size and ultimate distribution, the *great occipital nerve*. It supplies the skin of the scalp.

The internal branch from the posterior primary division of *the third cervical nerve* gives a cutaneous branch which occasionally reaches the scalp, and then lies to the inner side of the great occipital. It is termed the *occasional third occipital*.

The internal branches from the posterior primary divisions of *the fourth and fifth cervical nerves* supply the skin over the trapezius muscle in the ordinary manner.

The internal branches from the posterior primary divisions of *the three lower cervical nerves*, i.e. the sixth, seventh, and eighth, give no cutaneous branches, but terminate in the semispinalis colli muscle.

Dorsal Nerves.—The posterior primary divisions of *the upper six dorsal nerves* supply the skin by their *internal* branches, which emerge near the middle line of the body. The cutaneous branch from the second nerve extends outwards beyond the spine of the scapula.

The posterior primary divisions of *the lower six dorsal nerves* supply the skin by their *external* branches, which emerge in a line with the angles of the ribs and the outer border of the erector spinæ muscle.

Lumbar Nerves.—The posterior primary divisions of *the first, second, and third lumbar nerves* supply the skin by their external branches. These nerves pierce the aponeurosis of the latissimus dorsi, and, crossing the iliac crest near the outer border of the erector spinæ, supply the skin of the buttock.

The posterior primary divisions of *the fourth and fifth lumbar nerves* give no cutaneous branches at all, both the internal and external branches supplying muscles only.

Sacral Nerves.—The posterior primary divisions of *the first, second, and third sacral nerves* supply the skin by their external branches. After forming a series of loops they become cutaneous by piercing the gluteus maximus along a line drawn from the posterior superior iliac spine to the tip of the coccyx.

The posterior primary divisions of *the fourth and fifth sacral and the coccygeal nerves* do not divide into inner and outer branches.

Of the thirty-one pairs of spinal nerves the posterior primary divisions of all divide into internal and external branches, with the exception of the following four nerves :—

The first cervical nerve.

The fourth sacral nerve.

The fifth sacral nerve.

The coccygeal nerve.

The particular area of skin supplied by any given cutaneous branch from the posterior primary divisions of the spinal nerves is, in every instance, at a lower level than the origin of the posterior primary division from which such cutaneous nerves arise.

The Cutaneous Arteries of the Back.—All the foregoing cutaneous nerves of the back are accompanied by small cutaneous arteries, derived, in the dorsal and lumbar regions, from the dorsal branches of the intercostal and lumbar arteries.

The Muscles of the Back.—The muscles of the back may be arranged in six layers, as follows :—

First Layer.

The trapezius muscle.

The latissimus dorsi muscle.

Second Layer.

The levator anguli scapulæ muscle.

The rhomboideus minor muscle.

The rhomboideus major muscle.

Third Layer.

The serratus posticus superior muscle.

The serratus posticus inferior muscle.

Fourth Layer.

The splenius capitis et colli muscle.

The erector spinæ muscle.

Outer Column.

Ilio-costalis.

Musculus accessorius.

Cervicalis ascendens.

Middle Column.

Longissimus dorsi.

Transversalis cervicis.

Trachelo-mastoid.

Inner Column.

Spinalis dorsi.

Fifth Layer.

The complexus muscle.

The semispinalis colli et dorsi muscle.

The multifidus spinæ muscle.

Sixth Layer.

The *rotatores dorsi* muscles.

The *interspinales* muscles.

The *intertransversales* muscles.

Of these six layers the first two alone are of any importance. They are formed by muscles of the back which connect the upper limb to the trunk posteriorly, and are therefore always considered with the dissection of the upper extremity.

The Trapezius Muscle.—This is a large, flat, triangular muscle occupying the interval between the occiput and the level of the last dorsal vertebra.

Origin.—A *cranial* origin from the external occipital protuberance and the inner third of the superior curved line of the occiput.

A *cervical* origin from the ligamentum nuchæ and the spine of the seventh cervical vertebra.

A *dorsal* origin from the spines of all the dorsal vertebræ and their supraspinous ligaments.

Insertion.—The upper fibres are inserted into the outer third of the posterior surface of the clavicle.

The intermediate fibres pass transversely to the inner border of the acromion process and the upper border of the spine of the scapula.

The lower fibres ascend obliquely and terminate in a flat triangular tendon which glides over the smooth area at the root of the spine of the scapula to be inserted into a rough tubercle on the spine just beyond its root.

Nerve Supply.—The spinal accessory or the eleventh cranial nerve, and branches from the third and fourth cervical nerves. On the anterior or deep surface of the muscle these nerves form a plexus—the *subtrapezial plexus*—from which numerous branches are given off to the muscle.

Action.—The trapezius draws the scapula upwards and inwards.

Relations.—The *posterior* surface is subcutaneous.

The *anterior or deep* surface of the trapezius muscle rests upon, or conceals from view, the spinal accessory nerve and

the superficial cervical artery which accompanies that nerve; branches from the third and fourth cervical nerves, the subtrapezial plexus and several muscles.

The *upper or anterior* border forms the posterior boundary of the posterior triangle of the neck.

The *lower* border forms one of the boundaries of the *triangle of auscultation*. This triangle lies to the inner side of the inferior angle of the scapula, opposite the sixth intercostal space, and is bounded as follows:—

Externally.—By the rhomboideus major muscle.

Internally.—By the trapezius muscle.

Below.—By the latissimus dorsi muscle.

The Latissimus Dorsi Muscle.—This is a large, flat, triangular muscle, the base of which corresponds to the lower part of the vertebral column, and the apex to the axillary region.

Origin.—From the spines of the lower six dorsal vertebræ and their supraspinous ligaments.

From the spines of all the lumbar and sacral vertebræ, by means of the posterior lamella of the lumbar aponeurosis.

From the posterior fifth of the iliac crest by aponeurosis, and one inch in front of that by fleshy fibres.

From the lower three ribs by means of three fleshy digitations which interdigitate with the lower digitations of the external oblique muscle of the abdomen.

From the dorsal aspect of the lower angle of the scapula occasionally.

Insertion.—As the muscle passes to its insertion it winds round the lower border of the teres major muscle, so as to pass in front of it, and is finally inserted by a flat tendon, one and a half inches wide, into the floor of the bicipital groove of the humerus, a little higher than the insertion of the teres major.

Nerve Supply.—The long subscapular nerve from the posterior cord of the brachial plexus.

Action.—The latissimus dorsi draws the raised humerus downwards and backwards, and rotates it inwards, as in swimming.

The Levator Anguli Scapulæ Muscle.—This is a



triangular muscle situated at the side of the neck, between the upper part of the vertebral column and the superior angle of the scapula.

Origin.—By four tendinous slips from the posterior tubercles of the transverse processes of the first four cervical vertebræ, between the attachments of the splenius and scaleni muscles.

Insertion.—Into the base or vertebral border of the scapula, from the superior angle to the root of the spine.

Nerve Supply.—Branches from the third and fourth cervical nerves, and the nerve to the rhomboids from the fifth cervical nerve.

The Rhomboideus Minor Muscle.—*Origin.*—From the ligamentum nuchæ and the spines of the last cervical and first dorsal vertebræ.

Insertion.—Into the base or vertebral border of the scapula opposite the root of the spine.

Nerve Supply.—The nerve to the rhomboids from the fifth cervical nerve.

The Rhomboideus Major Muscle.—*Origin.*—From the spines of the first four or five dorsal vertebræ and their supraspinous ligaments.

Insertion.—Into the base of the scapula, between the root of the spine and the inferior angle.

Nerve Supply.—The nerve to the rhomboids from the fifth cervical nerve.

Action.—The levator anguli scapulæ and the rhomboids together elevate the superior angle and base of the scapula, thus counteracting the rotating action of the trapezius. If these muscles act simultaneously with the upper fibres of the trapezius the scapula is simply raised without rotation, as in shrugging the shoulders.

The two rhomboids acting alone form the special antagonists of the serratus magnus muscle.

On reflecting the second layer of muscles of the back, the posterior scapular artery and the nerve to the rhomboids are exposed.

The Posterior Scapular Artery.—The transverse cervical artery, from which the posterior scapular artery is derived, is

a branch of the thyroid axis from the first part of the subclavian artery.

The transverse cervical artery runs outwards a short distance above the clavicle, and crosses the anterior surface of the scalenus anticus muscle and the nerves of the brachial plexus. Under cover of the upper border of the trapezius, and near the anterior edge of the levator anguli scapulæ, it divides into two branches, the superficial cervical artery and the posterior scapular artery.

The superficial cervical artery ascends under cover of the trapezius, and supplies that muscle. It accompanies the spinal accessory nerve.

The posterior scapular artery passes backwards towards the upper angle of the scapula under cover of the levator anguli scapulæ, and then turns downwards along the vertebral border of the scapula, concealed by the rhomboids, towards the inferior angle. It anastomoses on both surfaces of the scapula with the suprascapular and subscapular arteries. The posterior scapular artery very frequently arises from the third part of the subclavian artery direct.

The superficial cervical and posterior scapular veins terminate in the external jugular vein just before it joins the subclavian vein.

The Nerve to the Rhomboids.—This nerve is derived from the trunk of the fifth cervical nerve close to the intervertebral foramen. It passes backwards through the fibres of the scalenus medius to the vertebral border of the scapula. The nerve lies in front of the levator anguli scapulæ and rhomboid muscles, all of which it supplies.

The Suprascapular Ligament.—This ligament bridges over the suprascapular notch of the scapula, converting it into a foramen. The suprascapular artery passes backwards above the ligament, whilst the nerve passes backwards through the foramen, and therefore below the ligament.

The Origin of the Omo-Hyoid Muscle.—The posterior belly of the omo-hyoid muscle arises from the upper border of the scapula near the notch, and from the suprascapular ligament.

The Suprascapular Artery.—This vessel supplies the dorsal surface of the scapula.

The Suprascapular Nerve.—This nerve is derived from the fifth and sixth nerves of the brachial plexus. It supplies the supraspinatus and infraspinatus muscles.

II. THE PECTORAL REGION AND AXILLA

The Cutaneous Nerves of the Pectoral Region.—These may be arranged in three groups.

Firstly, the Descending Branches from the Superficial Division of the Cervical Plexus.—These nerves are derived from the third and fourth nerves of the cervical plexus, and are three in number :—

1. The supra-sternal nerve crossing the sterno-clavicular articulation.

2. The supra-clavicular nerve crossing the middle of the clavicle.

3. The supra-acromial nerve crossing the outer third of the clavicle.

All these nerves lie, in the greater part of their course, in the neck, under cover of the superficial platysma myoides muscle, and supply the skin just below the clavicle.

Secondly, the Anterior Terminal Branches of the Intercostal Nerves.—These small nerves are the terminations of the anterior primary divisions of the upper six dorsal nerves. One nerve is found in each of the upper six intercostal spaces, and they become cutaneous by piercing the pectoralis major muscle close to the outer border of the sternum. They supply the skin over the sternum and front of the chest. Each nerve is accompanied by the perforating branches from the internal mammary artery.

Thirdly, the Lateral Cutaneous Branches of the Intercostal Nerves.—These nerves make their appearance on the side of the chest, between the digitations of the serratus magnus muscle, along a line placed rather behind the anterior fold of the axilla. Each nerve divides, under cover of the serratus magnus muscle, into an anterior and a posterior branch; the former passes forwards over the pectoralis major

muscle, and the latter backwards over the latissimus dorsi muscle.

It must be specially remembered that the first intercostal nerve gives off no lateral cutaneous branch at all, and that the second intercostal nerve gives off a lateral cutaneous branch, which does not divide into anterior and posterior branches, and which is not confined to the skin of the chest wall. This nerve crosses the axilla and supplies the skin of the upper arm, hence the lateral cutaneous branch of the second intercostal nerve is specially named the *intercosto-humeral* nerve.

The Superficial Fascia of the Pectoral Region.—This fascia encloses the mammary gland.

The Mammary Gland.—The mammary gland is, in the female, a smooth rounded prominence, which is situated in the superficial fascia. The mammæ are two in number, and are placed, one on each side, on the front of the thorax. A little below the centre of each mamma, at about the level of the fourth rib, there is the nipple, a small cylindrical or conical body which projects slightly upwards and outwards.

Each mammary gland extends, in a vertical line drawn through the nipple, from the second to the sixth or seventh ribs, and in a horizontal line through the same structure from just internal to the lateral edge of the sternum to the axillary border of the pectoralis major muscle opposite the fifth intercostal space.

The mammary gland is surrounded by a fibrous capsule which sends processes into its substance, thus dividing it into loculi, in which the secreting glandular structures are placed. From these secreting structures the *galactophorous ducts*, some twenty in number, converge upon the nipple.

The Lymphatics of the Mammæ.—These are of the highest importance in connection with the surgery of the gland. Five sets may be described:—

1. The intra-mammary lymphatics which accompany the blood vessels within the gland.
2. The cutaneous lymphatics.
3. The subareolar lymphatics.
4. The circum-mammary lymphatics.
5. The retro-mammary lymphatics.

The lymphatics from the inner part of the gland pass to join the small sternal glands found along the internal mammary artery.

The lymphatics from the outer part of the gland are much larger, and unite to form two or three principal trunks which pass to the lymphatic glands in the axilla.

The Arterial Supply of the Mammæ.—The arteries are derived from the long thoracic, the internal mammary, and the intercostal arteries.

In the adult male the mammæ and all their parts exist, but are in a rudimentary state.

The Deep Fascia of the Pectoral Region.—This is thin and unimportant. It encases the pectoralis major muscle. Above, it is attached to the clavicle; internally, to the front of the sternum; externally and below, it becomes continuous with the fasciæ of the shoulder and axilla respectively.

The Axilla.—The axilla may be defined as the hollow or recess situated between the upper part of the upper arm and the upper part of the chest wall. With the arm fully abducted the axilla is irregularly pyramidal in form, and therefore presents for examination a base, an apex, and four walls; the four walls are anterior, posterior, internal, and external. As the external wall, formed by the upper arm, is not so wide as the inner wall, formed by the chest, it necessarily follows that the anterior and posterior walls converge slightly as they pass outwards.

The Base of the Axilla.—The base of the axilla is wide and vaulted, and looks downwards and outwards. It is formed by the strong *axillary fascia*, a portion of deep fascia which stretches across the axilla from the anterior to the posterior fold. Attached to the upper surface of this axillary fascia there is the *clavi-pectoral fascia*, which sheet, attached above to the clavicle, passes downwards to enclose the pectoralis minor muscle and to become attached below to the upper surface of the axillary fascia. It draws the axillary fascia upwards towards the axilla, and so renders its lower surface concave.

The Apex of the Axilla.—The apex of the axilla is a small triangular interval, bounded, in front, by the clavicle; behind, by the superior border of the scapula; internally, by

the first rib. It forms the communication between the root of the neck and the axilla, and transmits the axillary vessels and the brachial nerves.

The Four Walls of the Axilla.—The walls of the axilla are anterior, posterior, internal, and external. In each wall of the axilla there are two muscles and one other structure. These are as follows:—

<i>In Front</i>	.	{	The pectoralis major muscle.
		{	The pectoralis minor muscle.
		{	The costo-coracoid membrane.
<i>Behind</i>	.	{	The subscapularis muscle.
		{	The tendon of the latissimus dorsi.
		{	The teres major muscle.
<i>Internally</i>	.	{	The serratus magnus muscle.
		{	The intercostal muscles of the upper four spaces.
		{	The upper five ribs.
<i>Externally</i>	.	{	The coraco-brachialis muscle.
		{	The short head of the biceps.
		{	The surgical neck of the humerus.

Contents of the Axilla.—These are as follows:—

The axillary artery and its branches, and twigs from the intercostal arteries.

The axillary vein and its tributaries, and the termination of the cephalic vein.

The brachial plexus and its branches, and the lateral cutaneous branches of the intercostal nerves.

Three sets of lymphatics, and areolar tissue and fat.

The Anterior Wall of the Axilla.—The anterior wall of the axilla is formed by the pectoralis major and minor muscles, and the costo-coracoid membrane. The *pectoralis major* muscle is the most superficial of the three structures, and covers the entire anterior wall of the axilla. The *pectoralis minor* lies behind the major and covers the middle third of the wall, whilst the *costo-coracoid membrane* is the upper portion of a sheet of fascia, to be presently described—the clavi-pectoral fascia. This costo-coracoid membrane is found in the upper part of the anterior wall, between the clavicle and the upper border of the pectoralis minor muscle. It is entirely concealed by the clavicular head of the pectoralis major.

In the anterior wall of the axilla are found the internal and external anterior thoracic nerves, and the acromio-thoracic and long thoracic vessels.

The Pectoralis Major Muscle.—This is a large, flat, triangular muscle situated in front of the thorax and the axilla.

Origin.—By two heads: A *clavicular* head of origin from the inner third, or half of the anterior surface of the clavicle.

A *chondro-sternal* head from the anterior surface of the sternum, the cartilages of the upper six ribs, and from the aponeurosis of the external oblique muscle of the abdomen.

Insertion.—By a bilaminar tendon into the outer lip of the bicipital groove of the humerus, with a slip up to the capsule of the shoulder-joint.

Nerve Supply.—The external and internal anterior thoracic nerves from the outer and inner cords of the brachial plexus.

Actions.—The pectoralis major adducts the upper arm and draws it forwards, that is, it flexes the shoulder-joint. It also rotates the humerus inwards.

Relations.—The *anterior* surface is almost entirely subcutaneous.

The *posterior* surface rests upon—

The clavi-pectoral fascia and the subclavius muscle.

The pectoralis minor muscle.

The third part of the axillary artery.

The coraco-brachialis and biceps muscles.

The *upper* border is nearly parallel to the deltoid, the two muscles being separated only by a slight interval which contains the cephalic vein and the humeral branch of the acromio-thoracic artery.

The *lower* border is folded upon itself, and forms the anterior fold of the axilla, assisted to a lesser extent by the pectoralis minor.

The Pectoralis Minor Muscle.—This is a small triangular muscle stretching from the ribs to the coracoid process.

Origin.—From the upper borders and outer surfaces of the third, fourth, and fifth ribs, near their cartilages, and from the anterior intercostal aponeuroses.

Insertion.—Into the anterior half of the inner border, and slightly into the superior surface of the coracoid process.

Nerve Supply.—The internal anterior thoracic nerve which pierces the muscle.

Action.—Draws the coracoid process downwards and forwards, but has no direct action upon the shoulder-joint.

Relations.—The *anterior* surface lies under cover of the pectoralis major muscle.

The *posterior* surface is in contact with the second part of the axillary artery and the adjoining veins and nerves.

The *upper* border lies below the costo-coracoid membrane.

The *lower* border is in contact with the long thoracic artery.

The pectoralis minor muscle covers the middle third of the anterior wall of the axilla, and is enclosed in the clavi-pectoral fascia which splits to enclose the muscle.

The Clavi-Pectoral Fascia.—This is an important sheet of deep fascia which lies in the anterior wall of the axilla behind the pectoralis major muscle. It extends from the clavicle above to the axillary fascia (base of the axilla) below, and it splits to enclose the pectoralis minor muscle. Externally, it is attached to the coracoid process and the fascia of the upper arm; internally, to the costal cartilages.

The thickness of the clavi-pectoral fascia varies considerably, and so permits of its division into three parts, as follows:—

1. The costo-coracoid membrane.
2. The bicornuate ligament.
3. The suspensory ligament of the axilla.

1. *The Costo-Coracoid Membrane.*—This is the uppermost and thickest part of the clavi-pectoral fascia. Above, it splits to enclose the subclavius muscle on the under surface of the clavicle, and is then attached to the anterior and posterior borders of that bone. Below, it terminates, just above the upper border of the pectoralis minor muscle, in the thickened crescentic margin known as the *bicornuate ligament*. Externally, it is attached to the coracoid process; and internally, to the first rib.

The costo-coracoid membrane and the adjacent portion of

the suspensory ligament of the axilla are pierced, above the level of the pectoralis minor muscle, by the following structures:—

(1) The thoracic axis artery, breaking up into:—

- | | |
|----------------|-------------|
| (a) Pectoral | } branches. |
| (b) Clavicular | |
| (c) Acromial | |
| (d) Humeral | |

(2) The thoracic axis vein.

(3) The cephalic vein.

(4) The external anterior thoracic nerve.

2. *The Bicornuate Ligament.*—This is the lower, thickened, and crescentic border of the costo-coracoid membrane. It is situated about midway between the subclavius muscle and the upper border of the pectoralis minor muscle.

3. *The Suspensory Ligament of the Axilla.*—This is the lowest and thinnest portion of the clavi-pectoral fascia. It extends from the bicornuate ligament above to the axillary fascia (base of the axilla) below, and splits to enclose the pectoralis minor muscle.

The clavi-pectoral fascia is of considerable practical importance, as it plays an important part in the determination of fluid effusions in this region.

The Posterior Wall of the Axilla.—This wall is somewhat longer than the anterior wall. It is formed, from above downwards, by the subscapularis, the tendon of the latissimus dorsi, and the teres major. Only a very small part of the last muscle is seen, and the posterior fold of the axilla is formed by the latissimus dorsi and teres major combined.

In this wall are found the posterior circumflex and subscapular vessels, the circumflex nerve, and the three subscapular nerves.

The Subscapularis Muscle.—*Origin.*—From the whole of the venter of the scapula, except the neck and that part of the vertebral border which gives insertion to the serratus magnus muscle.

Insertion.—By a broad tendon into the lesser tuberosity of the humerus, and the bone below for three-quarters of an inch. This tendon passes to its insertion below the coracoid

process, and behind the conjoined origins of the coracobrachialis and short head of the biceps.

Nerve Supply.—The short subscapular nerve and a twig from the middle subscapular, both nerves being derived from the posterior cord of the brachial plexus.

Actions.—The subscapularis rotates the humerus inwards and draws the arm to the side.

Relations.—The *anterior* surface is in contact, at its origin, with the serratus magnus muscle, and at its insertion it lies behind the coraco-brachialis and biceps. The intermediate portion of the muscle forms part of the posterior wall of the axilla.

The *posterior* surface is in contact with the scapula, a bursa and the capsule of the shoulder-joint. This bursa communicates, through an aperture in the capsular ligament, with the synovial membrane of the shoulder.

The Tendon of the Latissimus Dorsi Muscle.—This has been described in connection with the back. (*See* page 6.)

The Teres Major Muscle.—*Origin.*—From a flat oval surface on the dorsum of the scapula near its inferior angle, slightly from the axillary border of the bone, and from the intermuscular septum between it and the teres minor and infraspinatus muscles.

Insertion.—By a flat tendon, two inches wide, into the inner border of the bicipital groove of the humerus, behind and in contact with the tendon of the latissimus dorsi.

Nerve Supply.—The middle subscapular nerve, *i.e.* middle in length, not in position, from the posterior cord of the brachial plexus.

Actions.—Adducts the arm, and draws it behind the back, and also rotates the raised humerus inwards.

The Internal Wall of the Axilla.—This wall, which corresponds to the side of the chest, is longer than the external wall, which corresponds to the upper arm. It is formed by the serratus magnus muscle, the intercostal muscles of the upper four spaces, and the upper five ribs.

In this wall are found the superior or short thoracic artery, the external respiratory nerve of Bell, and the lateral cutaneous branches of the intercostal nerves.

The Serratus Magnus Muscle.—*Origin.*—This muscle arises by nine digitations from the outer surfaces of the upper eight ribs, about midway between their angles and the costal cartilages. Two digitations are attached to the second rib, and the lower three or four digitations interdigitate with the external oblique muscle of the abdomen.

Insertion.—Into the anterior or ventral surface of the scapula, along its vertebral border or base, and also into the small triangular surfaces in front of the upper and lower angles of the scapula.

The serratus magnus muscle consists of three parts. The *first* part is composed of the first digitation arising from the first and second ribs. It forms a thick bundle which is inserted into the upper angle of the scapula.

The *second* part is composed of the second and third digitations arising from the second and third ribs. This part is the thinnest part of the muscle and passes to be inserted into the vertebral border of the scapula.

The *third* part comprises the remaining digitations, and its fibres converge like a fan to form a thick mass, which is inserted into the lower angle of the scapula.

Nerve Supply.—The posterior thoracic nerve, or the external respiratory nerve of Bell, from the fifth, sixth, and seventh cervical nerves.

Action.—This muscle, by withdrawing the base of the scapula from the spinal column, enables the arm when raised from the shoulder to be still further outstretched, as in the movement termed extension, in fencing. The muscle also comes powerfully into action in all movements of pushing.

The External Wall of the Axilla.—This narrow wall is formed by the coraco-brachialis, the short head of the biceps, and the surgical neck of the humerus. It contains the great vessels and nerves, that is, the axillary vessels, and the nerves from the brachial plexus.

The Axillary Artery.—This vessel commences at the outer border of the first rib as the direct continuation of the subclavian artery, and terminates at the lower border of the teres major muscle by becoming directly continuous with the brachial artery.

Line of the Artery.—The course of the artery through the axilla varies with the position of the limb, but with the arm raised to the level of the shoulder, a line drawn from the middle of the clavicle to the inner side of the biceps and coraco-brachialis muscles will indicate the position of the artery.

In its course through the axilla the axillary artery is crossed by the pectoralis minor muscle, and is thus divided into three parts. The first part lies above the muscle, and is about one inch long; the second part lies behind the muscle, and is rather longer; the third part lies below the muscle, and is about three inches long. The third part is as long as the other two put together.

The First Part of the Axillary Artery.—The first part of the axillary artery extends from the outer border of the first rib to the upper border of the pectoralis minor muscle, that is to say, it lies above the pectoralis minor. It is very deeply situated and has the following relations:—

In Front.—There are the following structures, in order, from before backwards:—

The skin.

Superficial fascia.

Deep fascia.

The clavicular head of the pectoralis major muscle.

The deep fascia on the deep surface of the pectoralis major.

The costo-coracoid membrane, or the upper part of the clavi-pectoral fascia.

The axillary sheath.

In addition to the foregoing, the artery is crossed by the cephalic and acromio-thoracic axis veins, and the external anterior thoracic nerve; and, lastly, the subclavius muscle is also in front, if the shoulder be depressed.

Behind.—The first intercostal space, and the first digitation of the serratus magnus muscle.

The internal anterior thoracic and posterior thoracic nerves pass behind the artery.

Internally.—The axillary vein lies to the inner side of the artery and slightly overlaps it.

Externally.—The three cords of the brachial plexus.

The Second Part of the Axillary Artery.—This part of the vessel lies behind the pectoralis minor muscle, and extends from its upper to its lower border. It has the following relations:—

In Front.—There are the integuments and fasciæ, and the pectorales major and minor muscles.

Behind.—The posterior cord of the brachial plexus, but no muscular structure, this part of the vessel being separated from the subscapularis muscle by a quantity of fat.

Internally.—The axillary vein is separated from the artery by the inner cord of the brachial plexus and the internal anterior thoracic nerve.

Externally.—The outer cord of the brachial plexus.

The Third Part of the Axillary Artery.—The third part of the axillary artery lies below the pectoralis minor. It extends from the lower border of the pectoralis minor to the lower border of the teres major muscle. In the lower part of its extent it is comparatively superficial. Its relations are as follows:—

In Front.—The pectoralis major conceals the upper half of the artery, but in its lower half it is subcutaneous, being only covered by the integument and fasciæ.

The internal cutaneous nerve.

The inner head of the median nerve.

Behind.—The subscapularis muscle, and the tendons of the latissimus dorsi and teres major muscles.

The circumflex nerve.

The musculo-spiral nerve.

Internally.—The ulnar nerve lying between the artery and the vein.

The axillary vein.

The lesser internal cutaneous nerve internal to the vein.

Externally.—The coraco-brachialis muscle.

The external cutaneous nerve.

The median nerve.

The axillary vein lies to the inner side of all three parts of the artery, and tends to overlap the vessel somewhat.

The nervous relations vary with each part of the vessel. In the first part of the artery the three cords of the brachial plexus lie to its outer side.

In the second part of the artery the inner and posterior cords pass behind the artery to take up their positions on the inner side of and behind the vessel respectively; that is to say, the inner cord is on the inside, the outer cord is on the outside, and the posterior cord is behind.

In the third part of the vessel there are two nerves on each side. This is due to the fact that the three cords of the brachial plexus having terminated opposite the coracoid process by breaking up into their several branches, two of these branches come to lie on each side of the artery.

Branches of the Axillary Artery.—These may be summarised, with the part of the vessel from which they arise, and the wall of the axilla in which they lie, as follows:—

Superior or Short Thoracic	.	First part	.	Internal wall.
Acromio-Thoracic	.	Second part	.	Anterior wall.
Long Thoracic	.	Second part	.	Anterior wall.
Alar Thoracic	.	Third part	.	
Subscapular	.	Third part	.	Posterior wall.
Anterior Circumflex	.	Third part	.	External wall.
Posterior Circumflex	.	Third part	.	Posterior wall.

The Superior or the Short Thoracic Artery.—This is a small branch arising near the lower border of the subclavius muscle. It runs downwards and inwards across the first intercostal space to end in the pectoral muscles, anastomosing with the intercostal arteries.

The Acromio-Thoracic Artery or the Thoracic Axis.—This vessel arises from the front of the axillary artery near the upper border of the pectoralis minor, runs forwards through the costo-coracoid membrane for a quarter of an inch, and then divides into four branches—Clavicular, acromial, humeral, and pectoral.

The Long Thoracic or the External Mammary Artery.—This artery runs downwards and inwards along the lower border of the pectoralis minor to supply the serratus magnus and pectoral muscles and the mamma. It terminates about

the fifth intercostal space by anastomosing with the intercostal and thoracic arteries.

The Alar Thoracic Artery.—This is an inconstant vessel, which supplies the lymphatics and the fat of the axilla.

The Subscapular Artery.—This vessel is the largest branch of the axillary artery. It arises near the lower border of the subscapularis muscle, and runs downwards and backwards along that border of the muscle towards the inferior angle of the scapula, being accompanied by the long subscapular nerve. It supplies the subscapularis, serratus magnus, teres major, and latissimus dorsi muscles, and gives off one large branch, the dorsalis scapulæ artery.

The *dorsalis scapulæ artery* leaves the subscapular artery about one inch from its origin, and, turning backwards, grooves the axillary border of the scapula, passing between the bone and the teres minor muscle to ramify in the infraspinous fossa, where it anastomoses with the suprascapular and posterior scapular arteries.

The Anterior Circumflex Artery.—This artery passes outwards from the axillary artery behind the biceps and coraco-brachialis muscles, resting on the humerus until it reaches the bicipital groove, where it divides into two branches, *one* ascending with the long head of the biceps and supplying the head of the humerus and the capsule of the joint, *the other* running outwards to anastomose with the posterior circumflex artery.

The Posterior Circumflex Artery.—This artery arises immediately below the subscapular, and passes backwards with the circumflex nerve through the quadrilateral space. It winds round the humerus, and ends in the deltoid muscle. It anastomoses with the anterior circumflex, acromio-thoracic, and superior profunda arteries.

The Axillary Vein.—This vein commences opposite the lower border of the teres major muscle as the direct continuation of the basilic vein. It terminates opposite the outer border of the first rib by becoming directly continuous with the subclavian vein. It lies throughout on the inner side of the artery, and has similar relations to the surrounding muscles.

Tributaries.—Veins corresponding to all the branches of the artery. At the lower border of the subscapularis the axillary vein receives one or both of the venæ comites of the brachial artery, and near its termination it receives the cephalic vein.

The Axillary Sheath.—The axillary sheath is a sheath of fascia prolonged downwards from the neck behind the clavicle, and extending into the axilla for one and a half inches. It is derived from the prevertebral portion of the deep cervical fascia, and extends downwards and outwards over the scaleni muscles, the brachial plexus, and the subclavian vessels in the neck, into the upper part of the axilla. It thus comes to form the axillary sheath. This sheath is funnel-shaped, and consists of an anterior part in contact with the costo-coracoid membrane and closely united to it, and of a posterior part in contact with the serratus magnus.

The sheath contains the axillary artery and vein and the cords of the brachial plexus, the vein being innermost, the artery intermediate, and the nerves outermost.

The Brachial Plexus.—This large plexus, from which the nerves of the upper limb are derived, is formed principally by the union of the anterior primary divisions of the four lower cervical and the greater part of the first dorsal nerves. The plexus extends from the lower part of the neck to the axilla, terminating opposite the coracoid process of the scapula in the various nerves of the upper limb.

The Brachial Plexus is divisible in two parts—

A cervical or supra-clavicular portion.

An axillary or infra-clavicular portion.

The Cervical or Supra-clavicular Portion.—This portion, which includes the origin and mode of formation of the plexus, is considered with the head and neck.

The Axillary or Infra-clavicular Portion.—The axillary or infra-clavicular portion of the brachial plexus, as it appears in the arm, consists of three cords, outer, inner, and posterior, which commence behind the clavicle, and terminate opposite the coracoid process of the scapula by breaking up into the various nerves of the upper limb.

In this course the three cords of the plexus are placed

to the outer or acromial side of the first part of the axillary artery, being enclosed in the axillary sheath and lying behind the pectoralis major and subclavius muscles. The three cords of the brachial plexus surround the second part of the axillary artery in the manner indicated by their names—outer, inner, and posterior—and near their termination lie between the pectoralis minor and subscapularis muscles.

Infra-clavicular Branches of the Brachial Plexus.—The various branches which arise from the brachial plexus below the level of the clavicle may be classified as follows:—

From the Outer Cord.

The external anterior thoracic nerve.

The external cutaneous, or musculo-cutaneous nerve.

The external head of the median nerve.

From the Inner Cord.

The internal anterior thoracic nerve.

The internal cutaneous nerve.

The lesser internal cutaneous nerve, or the nerve of Wrisberg.

The internal head of the median nerve.

The ulnar nerve.

From the Posterior Cord.

The short subscapular nerve.

The middle subscapular nerve.

The long subscapular nerve.

The circumflex nerve.

The musculo-spiral nerve.

Of these infra-clavicular branches some are confined to the axilla, whilst the remainder pass onwards to the arm and are there discussed.

The *infra-clavicular* branches which are confined to the axilla are as follows:—

The external anterior thoracic nerve.

The internal anterior thoracic nerve.

The short subscapular nerve.

The middle subscapular nerve.

The long subscapular nerve.

In addition to these infra-clavicular branches there is one *supra-clavicular* branch which terminates in the axilla, and

which must therefore be considered with the axillary nerves. This nerve is the posterior thoracic nerve, or the external respiratory nerve of Bell.

The External Anterior Thoracic Nerve.—This nerve arises from the outer cord of the brachial plexus, behind the clavicle. It passes inwards in front of the first part of the axillary artery, and after forming a loop in front of that part of the vessel with the internal anterior thoracic nerve it pierces the costo-coracoid membrane, and terminates in the pectoralis major muscle, which it supplies.

The Internal Anterior Thoracic Nerve.—This nerve arises from the inner cord of the brachial plexus, and passes forwards between the axillary artery and vein. After forming the previously mentioned loop in front of the artery, the nerve terminates in many branches for the supply of the pectoralis minor muscle; some of these branches pierce the pectoralis minor and pass on to the lower part of the pectoralis major, consequently this nerve supplies both pectoral muscles.

The Short Subscapular Nerve.—This nerve, the uppermost in position, is derived from the posterior cord of the brachial plexus, and supplies the upper part of the subscapularis muscle.

The Middle Subscapular Nerve.—This nerve, the lowest in position, gives a branch to the lower part of the subscapularis muscle, and ends in the teres major muscle, which it also supplies.

The Long Subscapular Nerve.—This nerve, the middle in position and the largest of the three subscapular nerves, descends in company with the subscapular artery to enter the deep surface of the latissimus dorsi muscle, which it supplies.

The Posterior Thoracic Nerve, or the External Respiratory Nerve of Bell.—This nerve, a *supra-clavicular* branch of the brachial plexus, arises by three roots from the fifth, sixth, and seventh cervical nerves. It passes down behind the brachial plexus and the first part of the axillary artery to the outer surface of the serratus magnus, which it supplies.

The Lateral Cutaneous Branches of the Intercostal

Nerves.—These nerves make their appearance on the side of the chest, between the digitations of the serratus magnus muscle, along a line placed rather behind the anterior fold of the axilla.

The first intercostal nerve usually gives off no lateral cutaneous branch.

The branch from the second intercostal is named the *intercosto-humeral* nerve. It differs from the lateral cutaneous branches of the other intercostal nerves in not dividing into anterior and posterior branches, and in not being confined to the chest wall.

This nerve crosses the axilla to reach the upper arm, and is connected in the axilla with an offset of the nerve of Wrisberg. Piercing the fascia it becomes subcutaneous, and supplies the skin on the inner and posterior surfaces of the upper half of the upper arm.

The lateral cutaneous branches from the other intercostal nerves divide into anterior and posterior branches.

The Lymphatic Glands of the Axilla.—The axillary lymphatic glands are generally twelve or more in number, but both their number and size are very variable. They may be roughly classified into three groups, as follows:—

The *axillary glands*, from four to six in number, are placed along the axillary vessels in the outer wall of the axilla. They receive the lymphatic vessels which ascend from the limb, and are consequently most prone to enlargement in such surgical conditions as poisoned wounds of the fingers and other inflammatory affections of the limb.

The *pectoral glands*, four or five in number, lie farther forwards on the serratus magnus muscle, near the long thoracic artery, at the lower border of the pectoral muscles—that is, in the anterior wall of the axilla. These glands receive the lymphatics from the mamma and front of the chest, and are consequently the first glands to be enlarged in such diseases of the mamma as scirrhus, and after blistering and other superficial inflammations of the chest and upper part of the abdomen.

The *subscapular glands*, three or four in number, are situated at the back of the axilla, along the subscapular

vessels, and therefore in the posterior wall of the axilla. This group of glands receives the lymphatics from the back, and is therefore most liable to enlargement after bed-sores.

The efferent vessels from these three groups of glands ascend with the subclavian vein and form by their union a single trunk, the axillary lymphatic trunk, which terminates on the right side in the right lymphatic duct, and on the left side in the thoracic duct.

The Areolar Tissue and Fat.—The connective tissue found in the axilla is very loose. It thus facilitates the movements of the arm, but at the same time favours the extension of any pathological effusions within the space.

The Subclavius Muscle.—*Origin.*—By a short thick tendon from the first costal arch at the junction of the rib and cartilage, and just in front of the costo-clavicular or rhomboid ligament.

Insertion.—The muscle passes upwards and outwards to be inserted into the groove on the inferior surface of the clavicle, the muscle extending as far outwards as the recess between the conoid and trapezoid portions of the coraco-clavicular ligament.

Nerve Supply.—A small twig from the supra-clavicular portion of the brachial plexus, derived from the trunk formed by the fifth and sixth cervical nerves.

Action.—Depresses the clavicle.

III. THE SHOULDER AND SCAPULAR REGION

The Cutaneous Nerves of the Shoulder.—These are the supra-acromial branches from the third and fourth cervical nerves, and cutaneous branches from the circumflex nerve. The former have been described on page 9; the latter are described on page 28.

The Deltoid Muscle.—The deltoid muscle is a triangular muscle which assists in forming the prominence of the shoulder.

Origin.—Its origin may be divided into three parts:—

An *anterior* part, which arises from the outer third of the anterior surface of the clavicle.

A *middle* portion, from the tip and outer border of the acromion process.

A *posterior* portion, from the lower border of the spine of the scapula.

Insertion.—Into the deltoid eminence on the middle of the outer surface of the shaft of the humerus.

Nerve Supply.—The circumflex nerve from the posterior cord of the brachial plexus.

Action.—The deltoid abducts the humerus to a right angle at the shoulder joint.

Relations.—The *anterior* border is in contact with the pectoralis major. The cephalic vein and the humeral branch of the acromio-thoracic artery lie in the interval between the two muscles.

The *posterior* border is in relation to some cutaneous branches from the circumflex nerve.

The *outer* surface is subcutaneous, and is pierced by other cutaneous branches from the circumflex nerve.

The *deep* surface is in contact with a large bursa, which separates the deltoid muscle and acromion process from the shoulder-joint and its muscles.

The deltoid muscle *covers* the following structures:—

The origins of the biceps and coraco-brachialis muscles.

The insertions of the supraspinatus, infraspinatus, and teres minor muscles.

Parts of the long and outer heads of the triceps, and the circumflex vessels and nerve.

The Quadrilateral Space.—The quadrilateral space, which only exists after dissection, lies between the scapula and the humerus. When viewed from behind it is seen to be bounded as follows:—

Above, by the teres minor muscle.

Below, by the teres major muscle.

Externally, by the surgical neck of the humerus.

Internally, by the long head of the triceps.

When viewed from the front, the subscapularis muscle must be substituted for the teres minor.

Passing backwards through this space are the posterior circumflex vessels and the circumflex nerve.

The Posterior Circumflex Vessels.—*See* page 21.

The Circumflex Nerve.—The circumflex nerve is one of the terminal branches of the posterior cord of the brachial plexus. It lies first behind the axillary artery on the subscapularis muscle. At the lower border of that muscle it turns backwards with the posterior circumflex vessels through the quadrilateral space. The nerve then appears at the back of the shoulder lying between the two teres muscles, and external to the long head of the triceps.

After giving off its *articular branches* to the shoulder-joint, the circumflex nerve divides into an anterior or upper, and a posterior or lower branch.

The anterior or upper branch runs round the humerus, with the posterior circumflex vessels to the anterior border of the deltoid muscle, to which muscle it is distributed. It supplies its deep surface, and some of its fibres pierce the muscle to become cutaneous.

The posterior or lower branch gives off the nerve to the teres minor, on which there is a reddish gangliform enlargement. The nerve itself then turns round the posterior border of the deltoid below its middle, to supply the skin over the lower two-thirds of that muscle and over the adjacent part of the triceps.

The branches of the circumflex nerve may be summarised as follows:—

Muscular.

To the Deltoid.

To the Teres Minor.

Cutaneous.

Anterior or upper.	} To the skin over the lower part
Posterior or lower.	

Articular.

To the Shoulder-Joint.

The Triangular Space.—The triangular space, another space which only exists after dissection, and which lies immediately to the inner side of the quadrilateral space, is bounded as follows:—

Above, by the teres minor muscle.

Below, by the teres major muscle.

Externally, by the long head of the triceps.

The dorsalis scapulæ artery winds into this space, but does not pass through it. It disappears round the axillary border of the scapula, under cover of the teres minor.

The Muscles of the Shoulder.—The muscles of the shoulder, some of which have already been described, are as follows :—

The supraspinatus muscle.

The infraspinatus muscle.

The teres minor muscle.

The teres major muscle.

The subscapularis muscle.

The deltoid muscle.

The Supraspinatus Muscle.—*Origin.*—From the inner two-thirds of the supraspinous fossa of the scapula, and from the aponeurosis covering the muscle.

Insertion.—The fibres converge below the acromion process to a tendon, which is adherent to the capsule of the shoulder-joint and to the tendon of the infraspinatus, and which is inserted into the uppermost of the three facets on the greater tuberosity of the humerus.

Nerve Supply.—The suprascapular nerve, from the fifth and sixth cervical nerves.

Action.—A weak abductor of the humerus at the shoulder-joint.

The Infraspinatus Muscle.—*Origin.*—From the inner two-thirds of the infraspinous fossa of the scapula, from the under surface of the spine of the scapula, and from the fascia covering the muscle.

Insertion.—Into the middle facet on the greater tuberosity of the humerus. Its tendon of insertion is in contact with, and adherent to, the capsular ligament of the shoulder-joint.

Nerve Supply.—The suprascapular nerve.

Actions.—Rotates the hanging humerus outwards, and carries the arm backwards.

The Teres Minor Muscle.—*Origin.*—From a narrow obliquely grooved surface on the dorsum of the axillary border of the scapula, and from the intermuscular septa between it and the infraspinatus and teres major muscles.

Insertion.—Into the lowest facet on the greater tuberosity of the humerus, and into part of the shaft of the bone below it.

Nerve Supply.—The posterior or lower branch of the circumflex nerve.

Action.—Rotates the humerus outwards.

Relations.—The anterior or deep surface of this muscle is in contact with the long head of the triceps and the capsule of the shoulder-joint. The dorsalis scapulæ artery passes between this surface of the muscle and the infraspinous fossa of the scapula. Near its insertion the teres minor is separated from the teres major by the long head of the triceps.

The Teres Major Muscle.—(See page 16.)

The Subscapularis Muscle.—(See page 15.)

The Deltoid Muscle.—(See page 26.)

The Suprascapular Artery.—This vessel, a branch of the thyroïd axis from the first part of the subclavian artery, passes outwards in front of the scalenus anticus muscle, but behind the clavicle to the upper border of the scapula, where it is joined by the suprascapular nerve. The artery passes above the suprascapular ligament, and inclining downwards enters the supraspinous fossa, which it supplies. It is then continued down behind the neck of the scapula into the infraspinous fossa, where it terminates by anastomosing with the dorsalis scapulæ and posterior scapular arteries.

Branches.—The most important of the numerous small branches given off by this vessel are the medullary or nutrient artery of the clavicle, the principal nutrient artery of the scapula, and a small subscapular branch which anastomoses in the subscapular fossa of the scapula with the posterior scapular and subscapular arteries.

The Suprascapular Nerve.—This nerve arises from the back of the trunk formed by the union of the anterior primary divisions of the fifth and sixth cervical nerves. It passes outwards and backwards under cover of the trapezius and omo-hyoid muscles to the upper border of the scapula. It enters the supraspinous fossa below the suprascapular ligament, and therefore through the suprascapular foramen, and supplies the supraspinatus and infraspinatus muscles and the shoulder-joint.

The Arterial Anastomosis around the Scapula.—

Around the scapula there is a remarkably free arterial anastomosis. The chief vessels taking part in this anastomosis, the borders of the scapula along which they run, and their respective origins, may be classified as follows:—

Posterior scapular.	. Vertebral border.	. Transverse cervical (Thyroid axis).
Suprascapular. .	. Superior border.	. Thyroid axis (Subclavian).
Subscapular. .	. Axillary border.	. Axillary.
Dorsalis scapulae.	. Axillary border.	. Subscapular.

All these vessels freely anastomose together and give off numerous small branches which pass to both the dorsal and ventral surfaces of the scapula. This anastomosis is of considerable practical importance in re-establishing the collateral circulation after ligation of the third part of the subclavian or the first part of the axillary artery.

IV. THE ANTICUBITAL FOSSA

The Anticubital Fossa.—The anticubital fossa is the hollow situated in front of the elbow-joint between the pronator radii teres and the supinator longus muscles. It is triangular in shape, with the base uppermost.

The base is formed by an imaginary line drawn between the two condyles of the humerus.

The outer boundary is formed by the supinator longus muscle.

The inner boundary by the pronator radii teres muscle.

The apex by the meeting of these two muscles.

The floor of the fossa is formed by portions of the humerus, radius, and ulna, concealed by the brachialis anticus and supinator brevis muscles.

The roof is formed by the deep fascia. Lying in the superficial fascia, and therefore superficial to the fossa itself, are the important median-basilic and median-cephalic veins, and the internal, and external or musculo-cutaneous nerves.

Contents of the Anticubital Fossa.—The tendon of the biceps is directed outwards towards the outer boundary (the supinator longus) to reach the radius.

To the outer side of the tendon of the biceps, concealed and overlapped by the supinator longus, are the musculospiral nerve and the radial recurrent artery.

Immediately to the inner side of the tendon of the biceps is the brachial artery, dividing into its two terminal branches, radial and ulnar.

Immediately to the inner side of the brachial artery is the median nerve, together with the anterior ulnar recurrent vessels.

The remaining contents are fat and a few lymphatic glands.

V. THE FRONT OF THE UPPER ARM

The Cutaneous Nerves.—The cutaneous nerves of the upper extremity, from the shoulder to the wrist, are so numerous and important that it is not only convenient, but also desirable, to discuss all the nerves of the arm and forearm together, rather than merely to describe the cutaneous nerves of this particular region.

The cutaneous nerves of the arm and forearm are seven in number, and are derived from three sources, as follows:—

From the Brachial Plexus.

1. The external, or musculo-cutaneous nerve.
2. The internal cutaneous nerve.
3. The lesser internal cutaneous nerve.

From the Musculo-Spiral Nerve.

4. The internal cutaneous branch.
5. The upper external cutaneous branch.
6. The lower external cutaneous branch.

From the Second Intercostal Nerve.

7. The intercosto-humeral nerve.

As regards the actual cutaneous distribution of these seven nerves, they may be classified into two groups:—

1. *A Group supplying mainly the Outer Side of the Arm and Forearm.*

The upper external cutaneous branch of the musculospiral nerve.

The lower external cutaneous branch of the musculo-spiral nerve.

The cutaneous part of the external or musculo-cutaneous nerve.

2. *A Group supplying mainly the Inner Side of the Arm and Forearm.*

The intercosto-humeral nerve.

The internal cutaneous branch of the musculo-spiral nerve.

The lesser internal cutaneous nerve.

The internal cutaneous nerve.

The Upper External Cutaneous Branch of the Musculo-Spiral.—This nerve arises from the musculo-spiral nerve just before that nerve pierces the external intermuscular septum. It pierces the deep fascia just below the insertion of the deltoid and runs downwards, along the cephalic vein, to the anterior part of the elbow, supplying the skin on the outer and anterior aspects of the lower half of the upper arm.

The Lower External Cutaneous Branch of the Musculo-Spiral Nerve.—This nerve, arising similarly to the last one, runs downwards in the interval between the external condyle and the olecranon process, and extends as far as the wrist. It supplies the skin over the lower half of the upper arm and the forearm on their posterior aspects, as low down as the wrist, or even a little lower.

The Cutaneous Part of the External or Musculo-Cutaneous Nerve.—This nerve becomes cutaneous by piercing the deep fascia just above the elbow and on the outer side of the biceps. It then descends behind the median-cephalic vein and divides into two branches, anterior and posterior.

The *anterior* branch runs downwards near the radial border of the forearm, terminating over the thenar eminence. It supplies the skin over the outer half of the anterior surface of the forearm.

The *posterior* branch is directed outwards to the back of the forearm, and extends downwards as far as the wrist. It supplies the skin over the outer half of the posterior surface of the forearm.

The Intercosto-Humeral Nerve, or the Lateral Cutaneous

Branch of the Second Intercostal Nerve.—This nerve crosses the axilla to reach the upper arm. In the axilla it is connected with an offset from the lesser internal cutaneous nerve or the nerve of Wrisberg. Piercing the deep fascia it becomes cutaneous, and supplies the skin of the upper half of the upper arm on its inner and posterior aspects.

The Internal Cutaneous Branch of the Musculo-Spiral Nerve.—This nerve passes downwards and backwards behind the intercosto-humeral nerve, and at a deeper plane. It extends almost to the olecranon process, and supplies the skin over the long head of the triceps.

The Lesser Internal Cutaneous Nerve, or the Nerve of Wrisberg.—This nerve descends along the inner side of the basilic vein to about the middle of the upper arm, where it pierces the deep fascia and is continued onwards to the interval between the internal condyle of the humerus and the olecranon process, where it terminates.

The Internal Cutaneous Nerve.—This nerve pierces the deep fascia about half-way down the inner side of the upper arm, close to the basilic vein, and a short distance in front of the nerve of Wrisberg. As the nerve pierces the deep fascia it divides into two branches, one destined for the anterior, the other for the posterior surface of the forearm.

The *anterior division*, at the bend of the elbow, passes behind the median-basilic vein, and supplies the skin on the inner half of the front of the forearm as far as the wrist, where it terminates.

The *posterior division*, the smaller of the two, passes to the inner side of the basilic vein, and, descending in front of the internal condyle of the humerus, extends as far as the wrist. The nerve sends its branches obliquely backwards round the inner margin of the forearm, to supply the skin as far as the subcutaneous border of the ulna.

The Cutaneous Veins.—With the veins, as with the nerves, it is preferable to consider all the superficial veins of the forearm and arm together, rather than the veins of one region alone.

The Median Vein.—The median vein commences in a fine

venous plexus in the palm of the hand, or almost as frequently as the principal venous outlet of the dorsal plexus of the hand on its outer side. It then passes upwards to the front of the elbow, where it ends by dividing into the median-cephalic and the median-basilic veins. Just before its bifurcation this vein communicates with the deep veins of the forearm by the *deep median* or *profunda vein*.

The Median-Cephalic Vein.—The median-cephalic vein runs outwards between the biceps and supinator longus muscles, and, passing in front of the musculo-cutaneous nerve, joins the *radial vein* to form the cephalic vein. It is smaller and more nearly vertical than the median-basilic vein.

The Cephalic Vein.—The cephalic vein passes upwards first on the outer side of the biceps, and then between the pectoralis major and deltoid muscles. Piercing the costo-coracoid membrane, it crosses the first part of the axillary artery, and terminates in the axillary vein.

The Median-Basilic Vein.—The median-basilic vein, larger and more oblique than the median-cephalic vein, passes upwards and inwards in front of the brachial artery, from which it is only separated by the bicipital fascia; it is crossed by branches of the internal cutaneous nerve, and ends by joining the *anterior and posterior ulnar veins* to form the basilic vein.

This vein is of considerable practical importance, as it is the vein usually, though by no means always, selected for the operations of transfusion and venesection. Its relations, just mentioned, should consequently be carefully noted.

The Basilic Vein.—The basilic vein ascends on the inner side of the biceps, and, piercing the deep fascia a little below the middle of the upper arm, lies to the inner side of the brachial artery. It ends at the lower border of the teres major by becoming the axillary vein.

The Deep Fascia of the Upper Arm, or the Brachial Aponeurosis.—The deep fascia surrounds and entirely invests the upper arm.

Above, it is continuous with the axillary fascia and the fascia over the shoulder; below, it is attached to the bony prominences around the elbow, in which region it is also

strengthened by means of the *bicipital or semilunar fascia* from the biceps muscle.

Passing inwards from the deep fascia to the supracondylar ridges of the humerus are two very distinct processes or septa, termed the *external and internal intermuscular septa*.

The *external intermuscular septum* passes from the deep fascia to the external supracondylar ridge and condyle of the humerus. It extends as high as the insertion of the deltoid muscle, and is pierced from behind forwards by the musculospiral nerve and the anterior branch of the superior profunda artery.

Arising from the anterior surface of the septum there are the following muscles:—The brachialis anticus, supinator longus, and extensor carpi radialis longior muscles.

From the posterior surface arise parts of the outer and inner heads of the triceps muscle.

The *internal intermuscular septum*, the stronger of the two, passes from the deep fascia to the internal supracondylar ridge and condyle of the humerus. It extends as high as the insertion of the coraco-brachialis muscle, and is pierced from before backwards by the ulnar nerve, the inferior profunda artery, and the posterior division of the anastomotic branch of the brachial artery.

Arising from the whole length of the anterior surface of the internal intermuscular septum is the brachialis anticus muscle; from the whole length of the posterior surface, the inner head of the triceps.

The two *intermuscular septa* divide the upper arm into two compartments, anterior and posterior. The anterior compartment, comprising the dissection of the region now under consideration, contains the musculo-cutaneous nerve, and the three muscles supplied by that nerve, which are—

The biceps flexor cubiti muscle.

The coraco-brachialis muscle.

The brachialis anticus muscle.

The anterior compartment also contains parts of the supinator longus and extensor carpi radialis longior muscles, the brachial artery and its venæ comites, and most of the terminal branches of the brachial plexus.

The posterior compartment lodges the triceps muscle and part of the nerve which supplies it, namely, the musculo-spiral nerve.

The Muscles on the Anterior Surface of the Upper Arm.—These muscles are three in number—The biceps flexor cubiti, the coraco-brachialis, and the brachialis anticus muscles.

The Biceps Flexor Cubiti.—*Origin.*—By two heads. The *short or internal head* arises, along with the coraco-brachialis, from the tip of the coracoid process of the scapula.

The *long head* arises from the upper end of the glenoid fossa of the scapula within the capsule of the shoulder-joint, and also from the glenoid ligament.

Insertion.—By two tendons, one of which is inserted into the rough posterior half of the tuberosity of the radius, and which is separated from the anterior smooth surface of that process by a synovial bursa.

The other insertion takes the form of a strong flat aponeurotic band called the *bicipital or semilunar* fascia, which passes downwards and inwards, and blends with the deep fascia of the forearm over the muscles arising from the internal condyle.

Nerve Supply.—The external or musculo-cutaneous nerve, from the outer cord of the brachial plexus.

Actions.—On the radio-ulnar articulations, powerful supination. On the elbow-joint, powerful flexion. On the shoulder-joint, slight abduction and adduction.

Relations.—The radial tendon of insertion passes backwards to the radius between the supinator longus and pronator radii teres muscles, and the semilunar fascia stretches across the brachial vessels and the median nerve.

The inner margin of the muscle is in contact in its upper half with the coraco-brachialis and its lower half with the brachial artery, to which artery this border of the muscle forms the surgical guide.

The Coraco-Brachialis.—*Origin.*—From the tip of the coracoid process and the short head of the biceps, between that muscle and the pectoralis minor.

Insertion.—Into the middle of the inner border of the shaft of the humerus for about two inches, this insertion being between the origins of the triceps and brachialis anticus muscles.

Nerve Supply.—The external or musculo-cutaneous nerve which pierces the muscle, and which is derived from the external cord of the brachial plexus.

Action.—Slightly adducts the arm and draws it upwards.

The Brachialis Anticus.—*Origin.*—From the lower half of the internal and external surfaces of the humerus, this origin extending as high up as, and embracing, the insertion of the deltoid.

From the internal intermuscular septum throughout its whole extent.

From the external intermuscular septum in its upper part, being separated from the lower part of the septum by the origins of the supinator longus and extensor carpi radialis longior muscles.

Insertion.—Into the inner part of the rough triangular surface on the front of the coronoid process and the tuberosity of the ulna. The deep surface of this insertion is in contact with the anterior ligament of the elbow-joint.

Nerve Supply.—The external or musculo-cutaneous nerve chiefly, and also by the musculo-spiral in its outer part.

Action.—A primary flexor of the elbow-joint.

The Brachial Artery.—This vessel commences at the lower border of the teres major muscle as the direct continuation of the axillary artery, and terminates opposite the neck of the radius by dividing into radial and ulnar arteries.

Line of the Artery.—The brachial artery gradually inclines from the inner side to the front of the limb, lying in the depression along the inner borders of the coracobrachialis and biceps muscles. A line drawn on the surface of the arm along this hollow will indicate the course of the vessel.

Relations.—*In Front.*—The skin and fascia of the upper arm as far as the bend of the elbow.

The bicipital or semilunar fascia, which separates the artery, near its termination, from the median-basilic vein.

Behind.—The long head of the triceps; the musculo-spiral nerve and the superior profunda artery, intervening.

The inner head of the triceps.

The insertion of the coraco-brachialis muscle.

The brachialis anticus muscle.

Externally.—The coraco-brachialis and the biceps muscles.

Relation of Veins to the Artery.—The artery is accompanied throughout by the two venæ comites.

The basilic vein lies on the inner side of the artery, but in its lower half is separated from it by the deep fascia of the upper arm.

The median-basilic vein crosses the artery at the bend of the elbow, being only separated from it by the semilunar fascia.

Relation of Nerves to the Artery.—The median nerve crosses the artery superficially, from above downwards, and from without inwards. Occasionally the nerve crosses behind the artery instead of in front of it, a variation which is of importance inasmuch as the nerve is an important guide to the artery in ligation of the vessel.

The internal cutaneous nerve lies in front of the artery until the nerve pierces the deep fascia about the middle of the upper arm.

The ulnar nerve lies on the inner side of the artery as far as the insertion of the coraco-brachialis muscle.

The musculo-spiral nerve lies behind the upper end of the artery.

Branches.—The branches of the brachial artery may be classified as follows:—

Cutaneous branches.

Muscular branches to four muscles.

To the coraco-brachialis.

To the biceps.

To the brachialis anticus.

To the deltoid.

Four named branches.

The superior profunda artery.

The inferior profunda artery.

The nutrient artery to the humerus.

The anastomotic artery.

The Superior Profunda Artery.—This artery arises from the back of the brachial just below its origin, and runs backwards between the inner and long heads of the triceps. Accompanied by the musculo-spiral nerve, the superior profunda artery winds round the back of the humerus in the spiral groove and under cover of the outer head of the triceps. Having gained the outer side of the humerus, the artery ends by dividing into two branches, anterior and posterior.

The *anterior* and smaller branch passes forwards with the musculo-spiral nerve through the external intermuscular septum into the interval between the supinator longus and brachialis anticus muscles, and anastomoses with the radial recurrent artery.

The *posterior* terminal branch runs downwards behind the external intermuscular septum, and anastomoses behind the external condyle of the humerus with the posterior interosseous recurrent artery.

The Inferior Profunda Artery.—This artery arises from the brachial artery about the middle of the upper arm. It accompanies the ulnar nerve, and passing downwards with that nerve pierces the internal intermuscular septum from before backwards. Continuing downwards behind the septum, the vessel terminates on the back of the internal condyle of the humerus by anastomosing with the posterior ulnar recurrent artery, and the posterior division of the anastomotic from the brachial.

The Nutrient Artery to the Humerus.—This artery arises about the middle of the upper arm, and, entering the humerus near the insertion of the coraco-brachialis, runs downwards towards the elbow. This vessel arises almost as frequently from the superior profunda artery, and occasionally from the inferior profunda artery.

The Anastomotic Artery.—This vessel arises from the brachial artery two inches above the bend of the elbow, and passes inwards on the brachialis anticus muscle, where it divides into an anterior and a posterior division.

The small *anterior* division passes downwards in front of the internal condyle of the humerus to anastomose with the anterior ulnar recurrent artery.

The larger *posterior* division passes backwards and pierces the internal intermuscular septum. It then turns outwards between the triceps and the humerus, to anastomose, just above the olecranon fossa, with the posterior division of the superior profunda. It also anastomoses, behind the internal condyle, with the inferior profunda and the posterior ulnar recurrent arteries.

The Anastomosis around the Elbow - Joint.—The arterial anastomosis around the elbow-joint is of a very free character. Its main outlines may be summarised as follows:—

An anastomosis in front of the external condyle of the humerus.

The anterior division of the superior profunda artery.

The radial recurrent artery.

An anastomosis behind the external condyle of the humerus.

The posterior division of the superior profunda artery.

The posterior interosseous recurrent artery.

An anastomosis in front of the internal condyle of the humerus.

The anterior division of the anastomotic artery.

The anterior ulnar recurrent artery.

An anastomosis behind the internal condyle of the humerus.

The inferior profunda artery and the posterior division of the anastomotic artery.

The posterior ulnar recurrent artery.

A transverse anastomosis above the olecranon fossa.

The posterior branch of the superior profunda artery.

The posterior division of the anastomotic artery.

The Internal Cutaneous Nerve.—This nerve arises from the inner cord of the brachial plexus. It is at first placed in front of the third part of the axillary and the upper part of the brachial arteries, and then descends superficially between the brachial artery and the basilic vein to about the middle of the upper arm, where it becomes cutaneous. (See page 34.)

The Lesser Internal Cutaneous Nerve, or the Nerve of Wrisberg.—This nerve arises from the inner cord of the brachial plexus in common with the large internal cutaneous nerve. It first lies behind the axillary vein, but soon appears on the inner side of that vessel, and then communicates with the intercosto-humeral nerve. The nerve then descends on the inner side of the basilic vein to about the middle of the upper arm, where it pierces the deep fascia and becomes cutaneous. (*See* page 34.)

The External, or the Musculo-Cutaneous Nerve.—This nerve arises from the outer cord of the brachial plexus opposite the lower border of the pectoralis minor. It perforates the coraco-brachialis muscle, which it supplies, and then passes obliquely across the upper arm, between the biceps and brachialis anticus muscles, to reach the outer side of the biceps just above the elbow, where it pierces the deep fascia and becomes cutaneous. (*See* page 33.)

Branches.—These may be classified as follows:—

Muscular—

Biceps.

Brachialis anticus.

Coraco-brachialis.

Articular to the elbow-joint.

Cutaneous terminal branches.

The Ulnar Nerve.—This nerve, the largest branch from the inner cord of the brachial plexus, first descends between the third part of the axillary artery and the axillary vein, and then on the inner side of the brachial artery as far as the middle of the upper arm.

The nerve then leaves the brachial artery, and, accompanied by the inferior profunda artery, passes through the internal intermuscular septum to the interval between the olecranon and the internal condyle of the humerus.

The Median Nerve.—This nerve arises by two heads from the outer and inner cords of the brachial plexus. It lies to the outer side of the third part of the axillary artery, and then crosses the brachial artery superficially and from without inwards.

VI. THE BACK OF THE UPPER ARM

The Triceps Extensor Cubiti. — This large muscle occupies the whole of the posterior compartment of the upper arm.

Origin.—By three heads:—

The *long*, middle, or scapular head arises from the lower part of the neck and adjacent portion of the axillary border of the scapula, lying between the subscapularis in front and the teres minor behind.

The *outer* head arises from the upper and outer part of the posterior surface of the shaft of the humerus from the teres minor above to the musculo-spiral groove below. Its lower fibres also arise from an aponeurotic arch formed by the external intermuscular septum as it bridges across the musculo-spiral groove.

The *inner* head, the shortest of the three, arises from the posterior surface of the shaft of the humerus below the musculo-spiral groove, reaching as high, on the inner side of the upper arm, as the insertion of the teres major. It also arises from the whole length of the posterior surface of the internal intermuscular septum, and from the lower part of the posterior surface of the external intermuscular septum.

Insertion.—Into the upper and outer parts of the olecranon process of the ulna.

Nerve Supply.—The musculo-spiral nerve from the posterior cord of the brachial plexus.

Action.—The triceps is a powerful extensor of the elbow-joint, and its long head also adducts the shoulder-joint.

The Musculo-Spiral Nerve. — This important nerve arises behind the axillary vessels from the posterior cord of the brachial plexus. It runs backwards with the superior profunda vessels, between the long and inner heads of the triceps, and reaches the outer side of the arm by passing through the musculo-spiral groove under cover of the outer head of the triceps.

It pierces the external intermuscular septum and descends between the brachialis anticus and supinator longus muscles to the external condyle of the humerus, in front of which it

ends by dividing into the radial and posterior interosseous nerves.

Branches of the Musculo-Spiral Nerve.—The branches of the musculo-spiral nerve may be arranged in two ways—either from the relations of their origin to the humerus, or according to the structures which they supply. These branches, and both their classifications, are extremely important surgically, as the musculo-spiral nerve is peculiarly liable to paralysis.

A. *From the Relations of their Origins to the Humerus.*

Branches arising on the Inner Side of the Humerus.

Muscular branches to the long and inner heads of the triceps.

The internal cutaneous branch of the musculo-spiral.

Branches arising behind the Humerus.

Muscular branches to the outer and inner heads of the triceps.

Muscular branches to the anconeus.

Branches arising on the Outer Side of the Humerus.

The upper external cutaneous branch.

The lower external cutaneous branch.

Muscular branches to the supinator longus, extensor carpi radialis longior, and brachialis anticus.

Articular branches to the elbow-joint.

B. *From the Structures supplied by the Branches.*

Cutaneous.

The internal cutaneous branch.

The upper external cutaneous branch.

The lower external cutaneous branch.

Muscular.

Brachialis anticus.

Extensor carpi radialis longior.

Anconeus.

Supinator longus.

Triceps.

Articular.

To the elbow-joint.

Cutaneous Branches.—These have already been considered. (See pages 33 and 34.)

Muscular Branches.—These are as follows:—

To the brachialis anticus.

To the extensor carpi radialis longior.

To the anconeus. The nerve to the anconeus muscle arises behind the humerus, and is slender and remarkable for its length. It descends in the substance of the inner head of the triceps to reach its destination.

To the supinator longus.

To the triceps. Muscular branches for the outer and inner heads of the triceps arise behind the humerus; in addition to which, muscular branches for the middle or long and inner heads of the triceps arise on the inner side of the humerus. This second nerve to the inner head of the triceps constitutes the *ulnar collateral nerve of Krause*. It arises from the musculo-spiral nerve on the inner side of the humerus, supplies filaments to the upper part of the inner head of the triceps, and then descends with the ulnar nerve, to which it is often adherent, and re-enters the inner head of the triceps at its lower part.

Articular Branches.—Articular filaments are given off to the outer side of the elbow-joint.

VII. THE SUPERFICIAL DISSECTION OF THE FRONT OF THE FOREARM

The Cutaneous Nerves.—These are as follows:—

The internal cutaneous nerve.

The musculo-cutaneous nerve.

The lower external cutaneous branch of the musculo-spiral nerve.

The palmar cutaneous branch of the radial nerve.

The palmar cutaneous branch of the median nerve.

The palmar cutaneous branch of the ulnar nerve.

The first three of these nerves have already been described. (See pages 33 and 34.)

The Palmar Cutaneous Branch of the Radial Nerve.—This small nerve usually arises from that branch of the radial nerve which supplies the skin over the outer side of the thumb. It passes downwards on the outer side of the fore-

arm and then in front of the tendon of the extensor ossis metacarpi pollicis to end in the skin over the upper part of the thenar eminence.

The Palmar Cutaneous Branch of the Median Nerve.—This nerve arises from the median just above the anterior annular ligament of the wrist. It pierces the deep fascia between the tendons of the palmaris longus and flexor carpi radialis muscles, passes in front of the anterior annular ligament, and supplies the skin of the upper part of the palm.

The Palmar Cutaneous Branch of the Ulnar Nerve.—This long, slender nerve arises from the ulnar nerve in the middle of the forearm. It runs downwards in front of the ulnar artery, and only pierces the deep fascia to become cutaneous just above the anterior annular ligament. It enters the palm of the hand in front of the anterior annular ligament, and immediately to the outer side of the tendon of the flexor carpi ulnaris, and supplies the skin over the upper part of the hypothenar eminence.

The Deep Fascia on the Front of the Forearm.—This fascia is strong, and forms a complete investment for the forearm. Near the wrist it is specially thickened and specially named, forming the *anterior annular ligament*. This so-called ligament stretches from the tubercle of the scaphoid and the ridge of the trapezium on the radial side of the carpus, to the pisiform bone and the hook of the unciform on the ulnar side of the carpus.

Passing *in front of, or superficial to*, the anterior annular ligament are the following structures:—

The tendon of the palmaris longus muscle.

The ulnar artery.

The ulnar nerve.

The palmar cutaneous branch of the median nerve.

The palmar cutaneous branch of the ulnar nerve.

Passing *through* the ligament and resting in the groove on the trapezium is the tendon of the flexor carpi radialis.

Passing *behind, or deeper than*, the anterior annular ligament are:—

The tendons of the flexor sublimis digitorum muscle.

The tendons of the flexor profundus digitorum muscle.

The tendon of the flexor longus pollicis muscle.

The median nerve.

The Superficial Muscles of the Forearm.—The muscles on the front of the forearm are eight in number. They are all either pronators or flexors. All these muscles are supplied, either directly or indirectly, by the median nerve, with the exceptions of the one and a half inner muscles, namely, the flexor carpi ulnaris and the ulnar half of the flexor profundus digitorum, which are supplied by the ulnar nerve.

These eight muscles are divided into two groups, superficial and deep.

(a) The *superficial* muscles, five in number, and their nerve supplies are as follows:—

- | | |
|--|---------------------|
| 1. The pronator radii teres. | } The median nerve. |
| 2. The flexor carpi radialis. | |
| 3. The palmaris longus (inconstant). | |
| 4. The flexor sublimis digitorum. | |
| 5. The flexor carpi ulnaris. | The ulnar nerve. |

(b) The *deep* muscles are three in number. (See page 55.)

The Pronator Radii Teres.—This muscle crosses the upper part of the front of the forearm obliquely.

Origin.—By two heads, humeral and ulnar.

The *humeral* head, large and superficial, arises from the upper part of the internal condyle of the humerus, from the internal condyle itself by the common tendon, and from the fascia and intermuscular septum on its inner side.

The *ulnar* head, thin and deeply situated, arises from the inner margin of the coronoid process of the ulna. This head of origin joins the humeral head at an acute angle, and separates the median nerve and the ulnar artery.

Insertion.—The muscle passes downwards and outwards to be inserted into the rough impression on the middle of the outer surface of the shaft of the radius.

Nerve Supply.—The median nerve from the outer and inner cords of the brachial plexus.

Action.—The pronator radii teres pronates the hand at the radio-ulnar articulations, and flexes the elbow when pronation has been completed, or when that movement is prevented by antagonistic muscles.

Relations.—The radial vessels and nerve cross its insertion, which is concealed by the supinator longus muscle.

The median nerve enters the forearm between its two heads.

The Flexor Carpi Radialis.—*Origin.*—From the origin common to the flexors and pronators, *i.e.* the internal condyle of the humerus; and from the fascia and intermuscular septa on either side of the muscle.

Insertion.—Its tendon grooves the trapezium and passes through the anterior annular ligament to be inserted into the base of the second metacarpal, with usually a slip into the third.

Nerve Supply.—The median.

Action.—A *primary* flexor of the wrist and a slight and *secondary* flexor of the elbow. The muscle also acts as a weak pronator of the hand.

The Palmaris Longus.—*Origin.*—The common origin.

Insertion.—Into the palmar fascia, near the middle of the wrist, with frequently a slip to the abductor pollicis muscle.

Nerve Supply.—The median.

Action.—A *primary* flexor of the wrist and a slight and *secondary* flexor of the elbow. The muscle also renders the palmar fascia tense.

Relations.—The median nerve lies immediately behind it at the wrist. This muscle is absent in about 10 per cent. of cases.

The Flexor Sublimis Digitorum.—*Origin.*—By three heads, humeral, ulnar, and radial.

A *humeral* head from the common origin.

An *ulnar* head from the internal lateral ligament of the elbow and the inner margin of the coronoid process of the ulna.

A thin *radial* head from the anterior oblique line of the radius and its anterior border for two inches. This head of origin is not always present.

Insertion.—The muscle divides into four slips which are inserted into the second phalanges of the four inner digits. These tendons pass behind the anterior annular ligament in

pairs, those for the middle and ring fingers being in front of the other two.

Opposite the first phalanx each tendon divides into two parts, to permit the tendons of the flexor profundus digitorum to pass through them. They then reunite, and again divide to be inserted into a ridge at the middle of the lateral border of the second phalanx.

Nerve Supply.—The median.

Action.—This muscle acts as a *primary* flexor of the proximal interphalangeal articulations.

It also acts as a *secondary* flexor of the other joints over which it passes.

The Flexor Carpi Ulnaris.—*Origin.*—By two heads, humeral and ulnar.

A *humeral* head from the common origin.

An *ulnar* head from the inner side of the olecranon process and the posterior border of the ulna in its upper two-thirds, by means of an aponeurosis.

Insertion.—Into the pisiform bone. This muscle is the only muscle inserted into a carpal bone.

The pisi-metacarpal and pisi-uncinate ligaments are sometimes regarded as constituting additional insertions of the flexor carpi ulnaris into the base of the fifth metacarpal and into the unciform bones.

There is also an occasional insertion into the anterior annular ligament.

Nerve Supply.—The ulnar nerve from the inner cord of the brachial plexus.

Action.—A *primary* flexor of the wrist and a weak *secondary* flexor of the elbow.

Relations.—The ulnar nerve enters the forearm between its two heads, and remains covered by the muscle as far as the wrist.

The posterior ulnar recurrent artery passes upwards between the two heads of the muscle.

The ulnar artery is overlapped by the muscle from the middle of the forearm to within one inch of the wrist. Beyond that, the artery lies immediately to the outer side of the tendon.

The Radial Artery.—The radial artery commences opposite the neck of the radius, or a finger's breadth below the bend of the elbow, by the bifurcation of the brachial artery into radial and ulnar.

The vessel extends along the front of the forearm as far as the lower end of the radius; here it turns round the outer border of the wrist and descends to the upper or proximal end of the first intermetacarpal space, where it passes forwards into the palm of the hand, and terminates there by becoming the deep palmar arch.

These changes in the direction and course of the artery permit of its being divided into three parts—

A part in the forearm.

A part at the wrist.

A part in the hand.

The Radial Artery in the Forearm.—This part of the vessel, commencing in the manner and at the place indicated, descends with a nearly straight course along the outer part of the front of the forearm to the styloid process of the radius.

Line of the Artery.—The position of this part of the radial artery may be indicated by a line drawn from the middle of the bend of the elbow to the interval between the scaphoid bone and the extensor tendons of the thumb.

Relations of the Radial Artery in the Forearm.—These are as follows:—

In Front.—In the upper half of its course the artery is deeply situated, being covered by the supinator longus muscle. In its lower half it is superficial, being covered only by skin and fascia.

Behind.—From above downwards there are:—

The tendon of the biceps.

The supinator brevis muscle.

The pronator radii teres muscle.

The flexor sublimis digitorum muscle.

The flexor longus pollicis muscle.

The pronator quadratus muscle.

The lower end of the radius.

To the Inner Side there is the pronator radii teres muscle above, and the flexor carpi radialis muscle below.

To the Outer Side, the supinator longus muscle.

Relation of the Artery to Nerves.—The radial nerve lies on the outer side of the artery throughout. It approaches it in the upper third, lies in close contact with it in the middle third, and leaves it again in the lower third, passing under cover of the tendon of the supinator longus to gain the dorsum of the hand.

Relation of the Artery to Veins.—The artery is accompanied throughout by two venæ comites.

Branches in the Forearm.—The branches of the first part of the radial artery are as follows:—

The radial recurrent artery.

Muscular branches.

The anterior radial carpal artery.

The superficialis volæ artery.

The Radial Recurrent Artery.—This vessel arises from the radial soon after its origin, and runs upwards on the supinator brevis and brachialis anticus muscles. It is covered by the supinator longus muscle, and anastomoses with the anterior terminal branch of the superior profunda.

Muscular Branches.—Muscular branches are given off to the superficial muscles on the front of the forearm.

The Anterior Radial Carpal Artery.—The anterior radial carpal artery runs inwards along the lower border of the pronator quadratus, and anastomoses with the anterior ulnar carpal artery to form the anterior carpal arch.

The Superficialis Volæ Artery.—This vessel is a variable branch of small size, which usually ends in the muscles of the thumb. It may, however, complete the superficial palmar arch.

The Ulnar Artery.—This artery commences opposite the neck of the radius by the bifurcation of the brachial artery into radial and ulnar arteries. It leaves the forearm and enters the palm of the hand by passing in front of the anterior annular ligament.

In the forearm the artery lies between the superficial and deep muscles, running at first downwards and inwards, and then vertically downwards.

Relations.—In Front.—In the curved part of its course,

that is, in its upper third, the artery is deeply seated, being crossed by the pronator radii teres, flexor carpi radialis, palmaris longus, and flexor sublimis digitorum muscles.

From the middle of the forearm to within one inch of the wrist it is overlapped, on the inner side, by the flexor carpi ulnaris, and beyond that by fascia only; hence just above the wrist the ulnar artery is almost subcutaneous, and lies between the tendons of the flexor sublimis digitorum and flexor carpi ulnaris.

Behind.—Posteriorly, the ulnar artery rests upon the insertion of the brachialis anticus muscle, upon the flexor profundus digitorum, and the anterior annular ligament of the wrist.

Relation of Nerves to the Ulnar Artery.—The median nerve crosses the artery from within outwards, being separated from the vessel at the point of crossing by the ulnar head of the pronator radii teres.

The ulnar nerve lies to the ulnar side of the artery, separated from it above, but in close contact with it in the lower two-thirds of its extent.

The palmar cutaneous branch of the ulnar nerve descends in front of the lower part of the artery.

Relation of Veins to the Ulnar Artery.—Two venæ comites accompany the ulnar artery throughout.

Branches of the Ulnar Artery in the Forearm.—These are as follows:—

The anterior ulnar recurrent artery.

The posterior ulnar recurrent artery.

The common interosseous artery.

The posterior ulnar carpal artery.

The anterior ulnar carpal artery.

Muscular branches.

The ulnar metacarpal artery.

The Anterior Ulnar Recurrent Artery.—This small artery passes upwards and inwards in front of the internal condyle of the humerus to anastomose with the anterior division of the anastomotic branch of the brachial.

The Posterior Ulnar Recurrent Artery.—The posterior ulnar recurrent artery, larger than the anterior, runs inwards

and backwards under cover of the flexor sublimis digitorum, and then ascends behind the internal condyle of the humerus. It passes with the ulnar nerve between the two heads of the flexor carpi ulnaris, and anastomoses with the inferior profunda artery and with the posterior division of the anastomotic.

The Common Interosseous Artery.—The common interosseous artery is a short, wide trunk which arises from the ulnar artery, about one inch from its commencement; it runs backwards towards the upper border of the interosseous membrane, where it divides into anterior and posterior interosseous arteries.

The Posterior Ulnar Carpal Artery.—This small vessel arises a little above the pisiform bone, and reaches the dorsum of the wrist by passing under cover of the flexor carpi ulnaris. Under cover of the extensor tendons it anastomoses with the posterior radial carpal artery to form the posterior carpal arch.

The Anterior Ulnar Carpal Artery.—The anterior ulnar carpal artery runs outwards and joins the corresponding branch of the radial artery to form the anterior carpal arch.

Muscular Branches.—Muscular branches are given off to the muscles on the inner side of the forearm.

The Ulnar Metacarpal Artery.—This vessel arises near the lower end of the ulna, and runs along the inner side of the fifth metacarpal bone; this vessel is, however, very frequently derived from the posterior ulnar carpal artery.

The Radial Nerve.—This nerve commences in front of the external condyle of the humerus by the bifurcation of the musculo-spiral nerve into radial and posterior interosseous nerves.

The radial nerve passes downwards along the anterior border of the extensor carpi radialis longior to the outer side of the radial artery.

Three inches above the wrist the nerve leaves the radial artery and, turning backwards under cover of the tendon of the supinator longus, becomes cutaneous. This nerve is a purely cutaneous nerve, and supplies no muscles.

The Median Nerve.—This nerve enters the forearm between the two heads of the pronator radii teres, the ulnar head of which muscle separates the nerve from the ulnar artery.

The nerve passes straight down the forearm between the flexor sublimis and flexor profundus digitorum muscles; and in this course it crosses the ulnar artery from within outwards.

Just above the wrist the nerve lies behind the tendon of the palmaris longus and between the tendons of the flexor carpi radialis and the flexor sublimis digitorum.

The nerve then leaves the forearm and enters the palm of the hand behind the anterior annular ligament. The median nerve is accompanied in the forearm by the arteria comes nervi mediani, a branch from the anterior interosseous artery.

Branches in the Forearm.—*Articular branches* to the front of the elbow-joint.

Muscular branches, arising usually near the elbow-joint, supply the following muscles:—

The pronator radii teres.

The flexor carpi radialis.

The palmaris longus.

The flexor sublimis digitorum.

The anterior interosseous nerve. (See page 57.)

The palmar cutaneous branch. (See page 46.)

The Ulnar Nerve.—The ulnar nerve, passing from the interval between the olecranon process and the internal condyle of the humerus, enters the forearm between the two heads of the flexor carpi ulnaris. The nerve then runs straight down to the wrist, resting upon the flexor profundus digitorum, and overlapped by the flexor carpi ulnaris. About the middle of the forearm the nerve comes into contact with the ulnar vessels, and then remains to their inner side throughout. The nerve leaves the forearm and enters the palm of the hand by passing in front of the anterior annular ligament.

Branches in the Forearm.—*Articular branches* to the elbow-joint.

Muscular branches, arising near the elbow-joint, supply—

The flexor carpi ulnaris.

The ulnar half of the flexor profundus digitorum.

The *palmar cutaneous branch of the ulnar nerve* arises about the middle of the forearm, and runs downwards in front of the ulnar artery to the hand.

The *dorsal cutaneous branch of the ulnar nerve* arises about two or three inches above the wrist, and passes backwards under cover of the flexor carpi ulnaris to be distributed to the dorsum of the hand.

VIII. THE DEEP DISSECTION OF THE FRONT OF THE FOREARM

The Deep Muscles of the Forearm.—The three deep muscles on the front of the forearm, and their nerve supplies, are as follows:—

1. The flexor longus pollicis. . . . Anterior interosseous branch of the median nerve.
2. The flexor profundus digitorum. . . Anterior interosseous branch of the median and the ulnar nerve.
3. The pronator quadratus. Anterior interosseous branch of the median nerve.

The flexor longus pollicis rests upon the radius. The flexor profundus digitorum rests upon the ulna, and the pronator quadratus passes transversely between the two bones in the lower fourth of their extent.

The Flexor Longus Pollicis. — *Origin.* — From the anterior surface of the shaft of the radius from the oblique line above, to the upper edge of the pronator quadratus below.

From the adjacent part of the interosseous membrane, and occasionally from the internal condyle of the humerus or the coronoid process of the ulna.

Insertion.—Into the base of the terminal phalanx of the thumb.

Nerve Supply.—The anterior interosseous branch of the median nerve.

Action.—The flexor longus pollicis flexes the joints of the thumb and the wrist. It acts *primarily* upon the inter-

phalangeal joint of the pollex, and *secondarily* upon the other joints over which it passes.

The Flexor Profundus Digitorum.—*Origin.*—From the upper three-fourths of the anterior and internal surfaces of the shaft of the ulna.

From the ulnar half of the interosseous membrane for the same distance.

From the aponeurosis of the flexor carpi ulnaris.

Insertion.—The muscle divides into four tendons, only one of which—that for the index finger—is distinct from the rest, in the forearm. These tendons pass downwards behind the anterior annular ligament, and pierce the tendons of the flexor sublimis digitorum opposite the first phalanges, to be inserted into the terminal phalanges of the four inner digits.

Nerve Supply.—The anterior interosseous branch of the median nerve, and, in addition, the ulnar nerve.

Action.—This muscle acts as a *primary* flexor of the distal interphalangeal articulations. It also acts as a *secondary* flexor of all the other joints over which it passes.

Relations.—The upper end of the muscle embraces the insertion of the brachialis anticus.

The median nerve and the ulnar vessels and nerve lie on the muscle, concealed by the flexor sublimis digitorum and the flexor carpi ulnaris.

The outer border of the muscle is separated from the flexor longus pollicis by the anterior interosseous vessels and nerve.

The lumbrical muscles arise from its tendons in the palm.

The Pronator Quadratus.—*Origin.*—From the pronator ridge and the lower fourth of the anterior surface of the shaft of the ulna.

Insertion.—Into the front and inner part of the lower fourth of the shaft of the radius.

Nerve Supply.—The terminal branch of the anterior interosseous branch of the median nerve.

Action.—A powerful pronator of the hand, at the radio-ulnar articulations.

The Anterior Interosseous Artery.—This vessel, one of the terminal branches of the common interosseous branch of the ulnar artery, runs downwards upon the front of the interosseous membrane. It lies between the flexors longus pollicis and profundus digitorum, and is accompanied by the venæ comites and the anterior interosseous nerve. Opposite the upper border of the pronator quadratus muscle it pierces the interosseous membrane and runs downwards on the back of the forearm to the carpus, where it anastomoses with the posterior carpal arch and the posterior interosseous artery.

Branches.—*Muscular* to the deep muscles of the front of the forearm.

Nutrient to the radius and ulna.

The Arteria Comes Nervi Mediani, or the Median Artery.—

This vessel descends in the sheath of the median nerve, and finally ends either in the sheath of the flexor sublimis digitorum or by completing the superficial palmar arch.

The Anterior Communicating Branch runs downwards between the interosseous membrane and the pronator quadratus to anastomose with the anterior carpal arch.

The Anterior Interosseous Nerve.—This nerve arises from the median nerve a little below the elbow. It runs downwards on the interosseous membrane, with the artery of the same name, to the deep surface of the pronator quadratus, in which it ends. It supplies the three deep muscles of the forearm. The anterior interosseous nerve is entirely confined to the front of the forearm, whereas the artery is not, as it terminates on the back of the forearm.

IX. THE PALM OF THE HAND

The Superficial Structures of the Palm of the Hand.—

The superficial structures in the palm of the hand are three in number, as follows :—

The palmaris brevis muscle.

The superficial transverse ligament of the fingers.

The palmar cutaneous nerves.

The Palmaris Brevis Muscle.—This small muscle is a

remnant of the subcutaneous muscular sheet found in some of the lower animals, and which is termed the *panniculus carnosus*.

Origin.—From the inner margin of the palmar fascia and the anterior annular ligament.

Insertion.—Its fibres pass transversely inwards to be inserted into the skin along the inner border of the palm.

Nerve Supply.—The superficial division of the ulnar nerve.

The Superficial Transverse Ligament of the Fingers.

—This is a superficial band of transverse fibres, which stretches across the roots of the four fingers, and is contained in the folds of skin at the upper ends of the digital clefts.

The Palmar Cutaneous Nerves.—These small nerves, three in number, radial, median, and ulnar, have already been described. (*See page 45.*)

The Deep Fascia of the Palm of the Hand.—The deep fascia of the palm consists of three portions:—

An outer lateral part, thin and weak, covering the muscles of the thenar eminence.

A thick and strong central portion, commonly referred to as the palmar fascia.

An inner lateral part, thin and weak, covering the muscles of the hypothenar eminence.

The *central* portion of the deep fascia, or the *palmar fascia*, is formed principally from an expansion of the palmaris longus tendon, and to a lesser extent from the anterior annular ligament. It is pointed above, at the wrist, and becomes expanded and thinner below, at the fingers.

Just above the heads of the metacarpal bones the palmar fascia divides into four processes, which pass to the bases of the four inner digits and join the commencement of the digital sheaths. In the intervals between these digital slips the digital arteries and nerves and the lumbrical muscles will be seen.

The Superficial Palmar Arch.—The superficial palmar

arch is the continuation of the ulnar artery into the palm. The ulnar artery enters the hand by passing in front of the anterior annular ligament immediately to the outer side of the pisiform bone. Whilst in front of that ligament it gives off its deep branch, and then turns outwards across the palm of the hand to form the superficial palmar arch. This arch is completed on the radial side in one of four ways:—

By the *arteria radialis indicis*.

By the *arteria princeps pollicis*.

By the *superficialis volæ*.

By the *arteria comes nervi mediani*.

Line of the Arch.—With the thumb fully abducted draw a line across the hand at the level of the web of the thumb. The arch occupies the middle third of this line.

Relations.—The arch rests successively on the following structures:—

The anterior annular ligament.

The short muscles of the little finger.

The tendons of the *flexor sublimis digitorum*.

The digital branches of the median and ulnar nerves.

It is covered towards the ulnar border of the hand by the *palmaris brevis*, and afterwards by the palmar fascia and the integuments.

Branches.—The branches of the superficial palmar arch are digital, cutaneous, and muscular.

The *digital arteries* are four in number, and run downwards from the convexity of the arch to supply the three and a half inner digits. The thumb and radial side of the index finger are supplied by branches from the third part of the radial artery.

The first digital artery, which is often derived from the deep palmar arch, supplies the ulnar side of the little finger.

The second, third, and fourth digital arteries divide, opposite the roots of the fingers, into two *collateral* branches for the supply of the adjacent sides of the digits.

The digital arteries run downwards in the intervals between the flexor tendons, upon the digital nerves, and lumbrical muscles as far as the clefts of the fingers, where they are

joined by the palmar interosseous arteries from the deep palmar arch and the inferior perforating arteries from the dorsal interosseous arteries. In the fingers the nerves lie superficial to the arteries.

The Median Nerve.—This nerve enters the palm of the hand behind the anterior annular ligament, resting upon the flexor sublimis digitorum. In this part of its extent it lies in the synovial sheath which surrounds the flexor tendons at the wrist. Behind the anterior annular ligament the nerve divides into an outer and an inner division.

The outer division gives off a muscular branch, which supplies two and a half muscles of the thumb :—

The abductor pollicis.

The opponens pollicis.

The superficial head of the flexor brevis pollicis.

The outer division then gives off three digital nerves, which run to both sides of the thumb and the radial side of the index finger. These are termed the first, second, and third digital branches of the median nerve.

The inner division of the median nerve gives off two digital branches, the fourth and fifth respectively, which subdivide into two collateral branches for the supply of the adjacent sides of the index and middle, and middle and ring fingers.

In addition to thus supplying the skin of the fingers, all the digital branches of the median nerve, with the exception of the second, perform other functions as follows :—

The *first* digital nerve communicates with the radial nerve.

The *third* supplies the first or outermost lumbrical muscle.

The *fourth* supplies the second lumbrical.

The *fifth* communicates with the ulnar nerve, and sometimes supplies the third lumbrical, which then has a double nerve supply.

The five digital branches of the median nerve pass downwards behind the superficial palmar arch, but in the fingers they lie in front of the digital arteries.

The Ulnar Nerve.—The ulnar nerve enters the palm of the hand in front of the anterior annular ligament, lying be-

tween the artery and the pisiform bone. It divides into two branches, superficial and deep.

The superficial division supplies the palmaris brevis muscle, and then gives off two digital branches, one for the supply of the ulnar side of the little finger, and a second which subdivides into two collateral branches for the supply of the adjacent sides of the ring and little fingers.

The deep division accompanies the deep division of the ulnar artery, sinking deeply between the abductor and flexor brevis minimi digiti muscles. Passing to the inner side of, and below the hook of the unciform, through the opponens minimi digiti muscle, it accompanies the deep palmar arch, and supplies the following muscles:—

The three short muscles of the little finger.

The seven interossei muscles.

The two inner lumbricals.

The adductor obliquus and adductor transversus pollicis, with the deep head of the flexor brevis pollicis.

The ulnar nerve supplies one and a half muscles in the forearm and fifteen and a half muscles in the palm of the hand. The ulnar nerve is therefore the great motor nerve for the short muscles in the palm of the hand.

Synovial Sheaths of the Flexor Tendons at the Wrist.

—1. As the tendons of the flexor sublimis and flexor profundus digitorum muscles and the median nerve pass downwards behind the anterior annular ligament, they are surrounded and enveloped by a large, loose, synovial sac.

This synovial sac extends upwards to the level of the radio-carpal articulation, and downwards to about the middle of the palm in the case of the tendons to the index, middle, and ring fingers.

In the case of the little finger, however, the synovial sheath is prolonged downwards on the tendons of that digit to the beginning of the digital sheath of the little finger, with which it is, in most cases, continuous.

2. As the tendon of the flexor longus pollicis passes downwards behind the anterior annular ligament, it also has a synovial sheath which invests and surrounds the tendon.

It is continuous below with the digital sheath of the thumb, and occasionally communicates at the wrist with the common synovial bursa of the flexor tendons.

The Digital Sheaths of the Flexor Tendons.—The digital sheaths of the flexor tendons, by which the tendons of the flexor longus pollicis and flexor sublimis and flexor profundus digitorum muscles are bound down to their respective digits, are formed opposite the shafts of the first and second phalanges by strong bands of transverse fibres, termed the *vaginal ligaments*, which are attached to the sharp lateral margins of the palmar surfaces of the phalanges. Opposite the interphalangeal articulations, however, the vaginal ligaments are very much weaker, thus permitting the free flexion of the fingers.

The vaginal ligaments with the phalanges together form an osteo-fibrous canal or tube, which in the case of the pollex contains the tendon of the flexor longus pollicis, and in the other digits the tendons of the flexor sublimis and flexor profundus digitorum muscles. This osteo-fibrous canal is lined by synovial membrane.

In the case of the pollex this synovial membrane, as has already been seen, extends upwards above the anterior annular ligament.

In the case of the little finger it is uninterruptedly continuous with the synovial sac common to the flexor tendons at the wrist, but in the index, middle, and ring fingers the digital synovial sheaths do not extend upwards into the palm much beyond the heads of the metacarpals.

Certain reflections of the synovial membrane to the phalanges are termed the *vincula accessoria*. To see the *vincula accessoria*, open up the vaginal ligaments and gently lift the flexor tendons from the bones, when they will be brought into view. Two varieties of *vincula accessoria* are described, the *ligamenta longa* and the *ligamenta brevia*.

The ligamenta brevia are short membranous folds which pass between the tendons near their insertion and the phalanx immediately above that insertion.

The ligamenta longa are thin, slender, very inconstant bands, joining the tendons to a phalanx at a higher level.

The Muscles of the Palm.—The muscles of the palm of the hand comprise the five short muscles of the thumb, the three short muscles of the little finger, the four lumbrical muscles, the four dorsal interosseous muscles, the three palmar interosseous muscles, and the palmaris brevis. The last is an unimportant superficial muscle which has already been described. (*See page 57.*) All these muscles are supplied by the ulnar nerve, with the exception of the two outer lumbricals and the two and a half short muscles of the thumb which form the thenar eminence, all of which are supplied by the median nerve.

The Short Muscles of the Thumb.—The short muscles of the thumb are five in number—

The abductor pollicis	.	.	.	} Thenar eminence,
The opponens pollicis	.	.	.	
The flexor brevis pollicis.	{ (a) Superficial head.			
	{ (b) Deep head.			} Median nerve.
The adductor obliquus pollicis	.	.	.	
The adductor transversus pollicis	.	.	.	

				} Ulnar nerve.

The first two and a half muscles cover the first metacarpal bone, and constitute the thenar eminence.

The last two muscles lie behind the outer part of the hollow of the palm.

The Abductor Pollicis.—*Origin.*—From the tubercle of the scaphoid and the front of the anterior annular ligament.

Insertion.—Into the radial border of the base of the first phalanx of the thumb.

Nerve Supply.—The outer division of the median nerve.

Action.—Abducts the thumb.

The Opponens Pollicis.—*Origin.*—From the outer side of the ridge of the trapezium and the anterior annular ligament.

Insertion.—Into the whole length of the radial border and palmar surface of the first metacarpal bone.

Nerve Supply.—The outer division of the median nerve.

Action.—Opposes the thumb to the rest of the hand.

The Flexor Brevis Pollicis.—This muscle consists of two separate heads.

(a) *The Superficial or Outer Head.*—This head arises from the outer two-thirds of the lower border of the anterior annular ligament, and is *inserted* into the outer side of the base of the first phalanx of the thumb.

Nerve Supply.—The outer division of the median nerve.

Action.—Flexes the thumb at the metacarpo-phalangeal joint.

(b) *The Deep or Inner Head.*—This is seen on reflecting the abductor indicis from behind. It lies between the adductor obliquus pollicis and the outer head of the abductor indicis.

It *arises* from the ulnar side of the first metacarpal bone near its base, and is *inserted* into the ulnar side of the base of the first phalanx of the thumb.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Flexes the thumb at the metacarpo-phalangeal joint.

The Adductor Obliquus Pollicis.—*Origin.*—From the bases of the second and third metacarpals, from the os magnum, the anterior carpal ligaments, and from the sheath of the flexor carpi radialis.

Insertion.—Into the ulnar side of the base of the first phalanx of the thumb.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Adducts the thumb and slightly flexes the joint.

The Adductor Transversus Pollicis.—*Origin.*—From the lower two-thirds of the palmar aspect of the third metacarpal bone.

Insertion.—Into the ulnar side of the base of the first phalanx of the thumb.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Adducts the thumb.

Relations.—The deep palmar arch passes between the two adductors of the thumb.

The Short Muscles of the Little Finger.—These are three in number; together they constitute the hypothenar

eminence, and are all supplied by the deep division of the ulnar nerve.

The Abductor Minimi Digiti.—*Origin.*—From the pisiform bone and the anterior annular ligament.

Insertion.—Into the ulnar side of the base of the first phalanx of the little finger.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Abducts the little finger.

The Flexor Brevis Minimi Digiti.—*Origin.*—From the hook of the unciform and the anterior annular ligament.

Insertion.—Into the ulnar side of the base of the first phalanx of the little finger.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Flexes the little finger at the metacarpo-phalangeal joint.

The Opponens Minimi Digiti.—*Origin.*—From the hook of the unciform and the anterior annular ligament.

Insertion.—Into the whole length of the ulnar side of the fifth metacarpal.

Nerve Supply.—The deep branch of the ulnar nerve.

Action.—Opposes the little finger to the rest of the hand.

The Lumbrical Muscles.—These are four muscles which arise from the tendons of the flexor profundus digitorum in the palm of the hand. The two outer lumbricals arise from the radial side only of the first and second tendons respectively of the flexor profundus digitorum. The two inner lumbricals arise from the adjacent sides of the tendons between which they lie; that is, from the tendons of the flexor profundus which pass to the middle and ring, and ring and little fingers respectively. Each muscle passes round the radial side of its digit, to be *inserted* into the dorsal extensor expansion on the back of the fingers.

Nerve Supply.—The *first* lumbrical. The third digital branch from the outer division of the median nerve.

The *second* lumbrical. The fourth digital branch from the inner division of the median nerve.

The *third* lumbrical. The deep division of the ulnar nerve, and occasionally, in addition, the fifth digital branch from the inner division of the median nerve.

The *fourth* lumbrical. The deep division of the ulnar nerve.

Action.—The lumbricals *primarily* flex the metacarpophalangeal articulations, and *secondarily* extend the interphalangeal articulations, as in making the upstroke of a letter when writing.

The Radial Artery in the Palm of the Hand.—The radial artery enters the palm of the hand (from the dorsal surface of the wrist) between the heads of the abductor indicis, at the proximal end of the first intermetacarpal space. It gives off, behind the adductor obliquus pollicis muscle, the two large vessels known as the *arteria princeps pollicis* and the *arteria radialis indicis*, and then turns inwards to form the *deep palmar arch*.

The Arteria Princeps Pollicis.—This vessel passes downwards in front of the abductor indicis, between that muscle and the adductor obliquus pollicis, until it reaches the front of the metacarpal bone of the thumb. Here it divides into two collateral branches which run downwards on either side of the flexor longus pollicis tendon to supply both sides of the skin of the thumb on its palmar aspect.

The Arteria Radialis Indicis.—This vessel passes downwards along the radial side of the second metacarpal bone between the abductor indicis and the adductor transversus pollicis muscles. It supplies the radial side of the index finger on its palmar aspect.

The Deep Palmar Arch.—The deep palmar arch is the continuation of the radial artery in the palm of the hand. It commences at the proximal end of the first intermetacarpal space. Running transversely across the palm towards the fifth metacarpal bone, the deep palmar arch is completed on the ulnar side by the deep branch of the ulnar artery. It lies about a finger's breadth nearer the wrist than the superficial palmar arch.

The deep palmar arch rests on the interosseous muscles and on the bases of the metacarpal bones. It is covered by the following muscles:—

The adductor obliquus pollicis.

The flexor sublimis digitorum.

The flexor profundus digitorum.

The opponens minimi digiti.

The flexor brevis minimi digiti.

The deep branch of the ulnar nerve accompanies the arch from within outwards.

Branches. — *Recurrent branches* ascend to the anterior carpal arch.

Superior perforating arteries, three in number, pass backwards through the three inner intermetacarpal spaces to anastomose with the dorsal interosseous arteries.

Palmar interosseous arteries, three in number, run downwards to the clefts of the fingers, where they anastomose with the digital branches from the superficial arch.

X. THE BACK OF THE FOREARM

The Supinator and Extensor Muscles.—The muscles on the back of the forearm are twelve in number; they are all either supinators or extensors. They are divided into two groups, superficial and deep.

(a) The *superficial* muscles are seven in number, as follows:—

The supinator longus.

The extensor carpi radialis longior.

The extensor carpi radialis brevior.

The extensor communis digitorum.

The extensor minimi digiti.

The extensor carpi ulnaris.

The anconeus.

(b) The *deep* muscles are five in number. (See page 70.)

With three exceptions, all the muscles on the back of the forearm are supplied by the posterior interosseous branch of the musculo-spiral nerve. These three exceptions are:—

The supinator longus muscle.

The extensor carpi radialis longior.

The anconeus.

} The musculo-spiral
nerve direct.

The Supinator Longus.—*Origin.*—From the upper two-thirds of the external supracondylar ridge of the humerus and from the front of the external intermuscular septum.

Insertion.—Into an impression on the outer side of

the lower end of the radius near the base of the styloid process.

Nerve Supply.—The trunk of the musculo-spiral.

Action.—The supinator longus, though termed a supinator, takes but little part in that action. It is essentially a flexor of the elbow, acting most efficiently when the hand is placed midway between pronation and supination, and tending to bring the hand into that position when it is either fully supinated or pronated.

The Extensor Carpi Radialis Longior.—*Origin.*—From the lower third of the external supracondylar ridge of the humerus, from the front of the external intermuscular septum, and slightly from the external condyle of the humerus, by the common origin.

Insertion.—Into the radial side of the base of the second metacarpal bone.

Nerve Supply.—The trunk of the musculo-spiral.

Action.—A *primary* extensor of the wrist.

The Extensor Carpi Radialis Brevior.—*Origin.*—From the external condyle of the humerus by the common origin, from the external lateral ligament of the elbow-joint, from the fascia covering the muscle, and from the intermuscular septa on either side of the muscle.

Insertion.—Into the radial side of the base of the third metacarpal bone, immediately beyond its styloid process.

Nerve Supply.—The posterior interosseous branch of the musculo-spiral.

Action.—A *primary* extensor of the wrist.

The Extensor Communis Digitorum.—*Origin.*—From the common origin, that is, the external condyle of the humerus; and also from the fascia covering the muscle and the intermuscular septa on either side of it.

Insertion.—By means of the dorsal extensor expansion into the second and third phalanges of the four inner digits. This tendinous expansion is described in detail on page 75.

Nerve Supply.—The posterior interosseous nerve.

Action.—The extensor communis digitorum extends the fingers, its principal action taking place upon the metacarpophalangeal articulations.

Extension of the interphalangeal articulations is principally performed by the lumbrical and interossei muscles through the medium of the dorsal extensor expansion, and only to a lesser extent by the extensor communis digitorum. This muscle also acts as a secondary extensor of the wrist.

The Extensor Minimi Digiti.—*Origin.*—The common origin.

Insertion.—On the dorsum of the hand the tendon of this muscle splits into two, the *outer* division joins the fourth tendon of the extensor communis digitorum. The *inner* division takes part in the formation of the dorsal extensor expansion of the little finger, in the formation of which this tendon takes by far the greater share.

Nerve Supply.—The posterior interosseous nerve.

Action.—The special extensor of the little finger.

The Extensor Carpi Ulnaris.—*Origin.*—The common origin from the external condyle of the humerus, and also from the fascia of the forearm, and from the intermuscular septum between it and the extensor minimi digiti, and also slightly from the strong process of fascia which binds the muscle to the posterior border of the ulna.

Insertion.—Into the tuberosity on the base of the fifth metacarpal bone.

Nerve Supply.—The posterior interosseous nerve.

Action.—A *primary* extensor of the wrist, and also an adductor of that joint.

The Anconeus.—*Origin.*—By a narrow tendon from an impression on the lower and posterior part of the external condyle of the humerus.

Insertion.—The muscular fibres radiate from their origin like a fan, to be inserted into the radial aspect of the olecranon process and into the upper third of the shaft of the ulna.

Nerve Supply.—The trunk of the musculo-spiral nerve.

Action.—A *primary* extensor of the elbow-joint.

Relations.—The anconeus is subcutaneous throughout. Its deep surface is in contact with the supinator brevis, the external lateral ligament of the elbow-joint, and the posterior interosseous recurrent artery.

The Posterior Interosseous Artery. — This vessel, a branch of the common interosseous artery from the ulnar artery, reaches the back of the forearm by passing through the interval between the oblique ligament and the interosseous membrane. It is then seen between the supinator brevis and extensor ossis metacarpi pollicis muscles, where it gives off its recurrent branch. The vessel runs downwards between the superficial and deep muscles, and ends by anastomosing with the anterior interosseous and posterior carpal arteries.

It supplies the muscles on the back of the forearm, and in addition gives off one larger branch, the posterior interosseous recurrent artery.

The posterior interosseous recurrent artery passes directly upwards under cover of the anconeus to the back of the external condyle of the humerus, where it anastomoses with the posterior division of the superior profunda.

The Posterior Interosseous Nerve. — This nerve, one of the two terminal branches of the musculo-spiral, arises in front of the external condyle of the humerus.

It winds round the outer side of the neck of the radius, and, piercing the supinator brevis muscle, appears on the back of the forearm. It then runs downwards between the superficial and deep muscles to somewhat below the middle of the forearm, where it sinks under cover of the extensor longus pollicis, and so reaches the interosseous membrane, down which it now runs in company with the *anterior* interosseous artery. At the back of the wrist the nerve terminates, under cover of the tendons of the extensor indicis and the extensor communis digitorum, in a small fibrous enlargement, from which filaments are given off to the carpal ligaments and articulations.

This nerve supplies all the muscles on the back of the forearm except the supinator longus, the extensor carpi radialis longior, and the anconeus, which are supplied by the musculo-spiral direct.

The Deep Muscles on the Back of the Forearm. — These are five in number, as follows:—

The supinator brevis.

The extensor ossis metacarpi pollicis.

The extensor brevis pollicis.

The extensor longus pollicis.

The extensor indicis.

They are all supplied by the posterior interosseous branch of the musculo-spiral nerve.

The Supinator Brevis.—*Origin.*—From the external lateral ligament of the elbow-joint, from the orbicular ligament of the radius, and from the supinator ridge and posterior part of the bicipital fossa of the ulna.

Insertion.—The muscle surrounds the upper third of the radius, except at its inner part, and is inserted into the upper third of that bone, extending as far down as the insertion of the pronator radii teres. On the anterior and posterior surfaces of the radius the lower limits of the muscle are formed by the anterior and posterior oblique lines of the radius.

Nerve Supply.—The posterior interosseous nerve, which pierces the muscle.

Action.—A most powerful supinator of the forearm at the radio-ulnar articulations.

The Extensor Ossis Metacarpi Pollicis.—*Origin.*—From the upper third of the outer division of the posterior surface of the shaft of the ulna below the origin of the supinator brevis.

From the middle third of the posterior surface of the shaft of the radius below the insertion of the supinator brevis.

From the interosseous membrane between the two bones.

Insertion.—Into the radial side of the base of the metacarpal of the thumb.

Nerve Supply.—The posterior interosseous nerve.

Action.—An extensor of the thumb at its carpo-metacarpal articulation.

The Extensor Brevis Pollicis.—*Origin.*—From the interosseous membrane and the lower third of the posterior surface of the shaft of the radius.

Insertion.—Into the proximal end of the first phalanx of the thumb.

Nerve Supply.—The posterior interosseous nerve.

Action.—An extensor of the thumb at the metacarpophalangeal articulation.

The Extensor Longus Pollicis.—*Origin.*—From the middle third of the outer division of the posterior surface of the shaft of the ulna and from the interosseous membrane.

Insertion.—Into the base of the terminal phalanx of the thumb.

Nerve Supply.—The posterior interosseous nerve.

Action.—An extensor of the thumb at the interphalangeal articulation.

The Extensor Indicis.—*Origin.*—From the lower third of the outer division of the posterior surface of the shaft of the ulna and from the interosseous membrane.

Insertion.—The tendon of this muscle unites with that of the extensor communis digitorum destined for the index finger, to assist in forming the dorsal extensor expansion on that digit.

Nerve Supply.—The posterior interosseous nerve.

Action.—The special extensor of the index finger and a secondary extensor of the wrist.

Termination of the Anterior Interosseous Artery.—This vessel (described on page 57) appears on the back of the forearm by piercing the interosseous membrane about two inches above its lower end. It runs downwards, accompanied by the posterior interosseous nerve, under cover of the extensor longus pollicis, to end on the back of the carpus by anastomosing with the posterior carpal arch and the posterior interosseous artery.

XI. THE DORSAL ASPECT OF THE WRIST AND HAND

The Posterior Annular Ligament.—This is a specially thickened and specially named portion of the deep fascia which stretches obliquely across the back of the wrist. It is attached externally to the outer margin of the lower end of the radius, and passing obliquely downwards and inwards is attached internally to the cuneiform and pisiform bones and

the palmar fascia. The ligament sends processes forwards to the lower ends of the bones of the forearm and so forms six compartments for the passage of tendons.

The First Compartment is placed on the outer side of the base of the styloid process of the radius. It transmits:—

The extensor ossis metacarpi pollicis tendon.

The extensor brevis pollicis tendon.

The Second Compartment corresponds to the outermost groove on the back of the radius. It transmits:—

The extensor carpi radialis longior tendon.

The extensor carpi radialis brevior tendon.

The Third Compartment corresponds to the narrow oblique groove on the middle of the back of the radius. It transmits:—

The extensor longus pollicis tendon.

The Fourth Compartment corresponds to the wide, shallow, and innermost groove on the back of the radius. It transmits:—

The extensor communis digitorum tendons.

The extensor indicis tendon.

The Fifth Compartment occupies the interval between the radius and the ulna. It transmits:—

The extensor minimi digiti tendon.

The Sixth Compartment occupies the groove on the back of the ulna, lying between the styloid process and the head of that bone. It transmits:—

The extensor carpi ulnaris tendon.

The Dorsal Cutaneous Branch of the Ulnar Nerve.—

This nerve gains the back of the forearm two or three inches above the wrist by winding backwards under cover of the flexor carpi ulnaris. It then divides into branches for the supply of the skin on the inner side of the little finger and the adjacent sides of the little and ring fingers.

On the little finger the dorsal digital branches reach as far as the nail, but on the ring finger they do not usually reach beyond the second phalanx. This nerve usually communicates, on the back of the hand, with the radial nerve.

The Radial Nerve.—The radial nerve reaches the back of the forearm about three inches above the wrist by passing

backwards under cover of the tendon of the supinator longus. The nerve then divides into two branches as follows:—

The external branch supplies the radial side of the thumb, and distributes branches over the thenar eminence by means of the radial palmar cutaneous nerve.

The internal branch subdivides into four branches—the first for the ulnar side of the thumb, the second for the radial side of the index finger, the third for the adjacent sides of the index and middle fingers, and the fourth for the adjacent sides of the middle and ring fingers. This last branch communicates with the dorsal cutaneous branch of the ulnar nerve.

The distance to which these nerves extends varies. On the thumb they reach to the nail, on the index finger to the second phalanx, on the middle finger to the first phalanx, and, lastly, on the ring finger only to its root.

The Extensor Tendons of the Fingers.—The four tendons of the extensor communis digitorum, after emerging from the fourth compartment of the posterior annular ligament, diverge on the dorsum of the hand to reach the four fingers. Upon each finger, opposite the proximal phalanx, the tendon expands to form the dorsal extensor expansion. This dorsal extensor expansion is formed principally by the extensor communis digitorum, but is also joined by other tendons. On each finger there are therefore the following tendons:—

The index finger.

The extensor communis digitorum.

The extensor indicis.

The first lumbrical.

The first dorsal interosseous.

The first palmar interosseous.

The middle finger.

The extensor communis digitorum.

The second lumbrical.

The second dorsal interosseous.

The third dorsal interosseous.

The ring finger.

The extensor communis digitorum.

The third lumbrical.

The fourth dorsal interosseous.

The second palmar interosseous.

The little finger.

The extensor communis digitorum.

The extensor minimi digiti.

The fourth lumbrical.

The third palmar interosseous.

The dorsal extensor expansion having been formed over the proximal phalanx in this way, expands over the dorsal aspect of that phalanx so as to cover it completely, but opposite the proximal interphalangeal articulation it divides into three portions—a central and two lateral. The central division passes downwards to be inserted into the base of the second phalanx, whilst the stronger lateral portions pass downwards beyond this, re-unite, and are inserted into the base of the terminal or ungual phalanx. This mode of insertion of the dorsal extensor expansion is the same for each digit.

That tendon of the extensor communis digitorum, which passes to the ring finger, is connected by a tendinous slip with the tendon on either side of it, thus explaining the small amount of independent extension normally present in the ring finger.

The tendon of the extensor indicis joins the dorsal extensor expansion over the first phalanx of the index finger.

The tendon of the extensor minimi digiti, after emerging from the fifth compartment of the posterior annular ligament, splits into two parts. The outer part joins the fourth tendon of the extensor communis digitorum, the inner part takes part in the formation of the dorsal extensor expansion over the little finger.

The Radial Artery at the Wrist, or the Second Part of the Radial Artery.—Below the styloid process of the radius the radial artery turns backwards under cover of the tendons of the extensor ossis metacarpi pollicis, extensor brevis pollicis, and finally the extensor longus pollicis.

It rests upon the external lateral ligament of the wrist, the scaphoid and trapezium, and then disappears by passing between the two heads of the abductor indicis or the first dorsal interosseous muscle.

It is accompanied by two venæ comites and by some minute filaments from the musculo-cutaneous nerve.

Branches.—The second part of the radial artery gives off the following branches :—

The posterior radial carpal.

The first dorsal interosseous.

The two arteriæ dorsales pollicis.

The arteria dorsalis indicis.

The Posterior Radial Carpal Artery.—This vessel runs inwards on the back of the carpus, and unites with the posterior ulnar carpal artery to form the posterior carpal arch. This arch is deeply situated under cover of the extensor tendons. It gives off the second and third dorsal interosseous arteries, which run downwards in the third and fourth intermetacarpal spaces.

The First Dorsal Interosseous Artery.—This vessel runs downwards in the second intermetacarpal space. It sometimes arises from the posterior carpal arch.

The two Arteriæ Dorsales Pollicis.—These vessels supply both sides of the dorsal surface of the thumb.

The Arteria Dorsalis Indicis.—This vessel runs downwards along the radial side of the index finger, which it supplies.

Arterial Supply to the Dorsal Surface of the Digits.
—This may be summarised as follows :—

DIGIT.	VESSEL.	SOURCE.
Pollex.	The two arteriæ dorsales pollicis.	Second part of radial artery.
Index Finger	{ Radial side. Arteria dorsalis indicis.	Second part of radial artery.
	{ Ulnar side. } First dorsal interosseous artery.	Second part of radial artery.
Middle Finger	{ Radial side. } Second dorsal interosseous artery.	Posterior carpal arch.
	{ Ulnar side. } Second dorsal interosseous artery.	Posterior carpal arch.
Ring Finger	{ Radial side. } Third dorsal interosseous artery.	Posterior carpal arch.
	{ Ulnar side. } Third dorsal interosseous artery.	Posterior carpal arch.
Little Finger	{ Radial side. } Irregular.	
	{ Ulnar side. } Irregular.	

The dorsal interosseous arteries communicate with the vessels in the palm. At the proximal ends of the intermetacarpal spaces they communicate with the deep palmar

arch by means of the three superior perforating arteries, and at the distal ends of the intermetacarpal spaces with the palmar digital vessels by means of the inferior perforating arteries.

The Dorsal Interossei Muscles.—The dorsal interossei are four in number. They act as abductors of the metacarpophalangeal articulations from an imaginary line which is drawn through the centre of the longest digit, that is, the middle finger, and their insertions are arranged in strict accordance with this action.

Origin.—Each muscle arises by two heads from the adjacent sides of the two metacarpal bones between which it lies.

The second part of the radial artery disappears from the dorsal surface of the wrist between the two heads of origin of the first dorsal interosseous muscle, and the superior perforating arteries pass forwards between the two heads of origin of the other three muscles.

Insertions.—*The first dorsal interosseous*, or the abductor indicis, is inserted into the radial side of the base of the first phalanx of the index finger, and also into the dorsal extensor expansion of that digit.

The second dorsal interosseous is inserted into the radial side of the base of the first phalanx of the middle finger, and also into the dorsal extensor expansion of that digit.

The third dorsal interosseous is inserted into the ulnar side of the base of the first phalanx of the middle finger, and also into the dorsal extensor expansion of that digit.

The fourth dorsal interosseous is inserted into the ulnar side of the base of the first phalanx of the ring finger, and also into the dorsal extensor expansion of that digit.

The Palmar Interossei Muscles.—The palmar interossei are three in number. They act as adductors of the metacarpophalangeal articulations of the index, ring, and little fingers towards the imaginary line drawn through the centre of the middle finger. Each muscle is placed on the metacarpal bone of the finger upon which it acts.

The first palmar interosseous muscle arises from the ulnar side of the metacarpal of the index finger, and is inserted into

the ulnar side of the base of the first phalanx of that finger and into its dorsal extensor expansion.

The second palmar interosseous muscle arises from the radial side of the metacarpal of the ring finger, and is inserted into the radial side of the base of the first phalanx of that finger and into its dorsal extensor expansion.

The third palmar interosseous muscle arises from the radial side of the metacarpal of the little finger, and is inserted into the radial side of the base of the first phalanx of that finger and into its dorsal extensor expansion.

Nerve Supply.—All the interossei muscles are supplied by the deep division of the ulnar nerve.

THE LOWER EXTREMITY

A STUDY of the lower extremity comprises the following regions:—

The thigh.

1. The gluteal region.
2. The popliteal space.
3. The back of the thigh.
4. The superficial dissection of the front of the thigh.
5. Scarpa's triangle.
6. The deep dissection of the front of the thigh.
7. The internal or adductor region.

The leg.

8. The internal or tibial region.
9. The extensor or anterior tibio-fibular region, and the dorsum of the foot.
10. The external or peroneal region.
11. The posterior tibio-fibular or flexor region.

The foot.

12. The sole of the foot.

I. THE GLUTEAL REGION

The Superficial Fascia.—The superficial fascia over the gluteal region is usually lax and contains much fat—more especially in the female. Its laxity explains the large size which effusions in this region may attain; and the large amount of fat accounts for the frequency with which fatty tumours or lipomata occur in this particular part of the body.

Over the ischial tuberosities the superficial fascia is tough and stringy, as it is upon these prominences that the body rests in the sitting posture.

The Cutaneous Nerves of the Buttock.—In this region the cutaneous nerves are numerous, but of no very great practical importance. They are derived from both the posterior and anterior primary divisions of the spinal nerves, as follows:—

From the posterior primary divisions.

Branches from the first three sacral nerves, passing forwards.

Branches from the first three lumbar nerves, passing downwards.

From the anterior primary divisions.

The iliac branch of the ilio-hypogastric nerve.

The iliac or lateral cutaneous branch of the last dorsal nerve. Both these nerves pass downwards.

Branches from the posterior division of the external cutaneous nerve, passing backwards.

Branches from the small sciatic nerve.

The perforating cutaneous nerve of the sacral plexus.

The last two nerves pass upwards.

Branches from the Three Sacral Nerves.—These branches are usually two in number, and are derived from the external branches of the posterior primary divisions of the first three sacral nerves. These three nerves form a series of loops which lie on the posterior surface of the great sacro-sciatic ligament, and which are covered by the gluteus maximus muscle. From these loops two cutaneous nerves are given off. They become cutaneous by piercing the gluteus maximus muscle along a line drawn from the posterior superior iliac spine to the tip of the coccyx. The upper of the two nerves is situated near the lower part of the sacrum, the lower one opposite the coccyx.

Branches from the First Three Lumbar Nerves.—These branches are derived from the external branches of the posterior primary divisions of the first three lumbar nerves. They pierce the fleshy part of the ilio-costalis and the aponeurotic part of the latissimus dorsi muscles, and, crossing the crest of the ilium opposite the outer border of the erector spinæ, supply the skin of the buttock, usually extending as far as the great trochanter of the femur.

The Iliac Branch of the Ilio-Hypogastric Nerve.—This nerve usually crosses the crest of the ilium opposite the tubercle, about two and a half inches behind the anterior superior spine of the ilium. It supplies the skin over the gluteus medius and tensor fasciæ femoris muscles.

The Iliac, or Lateral Cutaneous Branch of the Last Dorsal Nerve.—This nerve, usually of considerable size, pierces the external oblique muscle at a variable distance above the iliac crest, and then, crossing that crest about one inch behind the anterior superior spine of the ilium, it supplies the skin over the anterior part of the buttock, and extends as far as the great trochanter.

The External Cutaneous Nerve.—The posterior branch of this nerve gives off numerous cutaneous filaments which pass backwards to supply the skin of the buttock and the back of the thigh. Its highest filaments extend up to the iliac crest, and are crossed vertically by the cutaneous branches from the last dorsal nerve.

The Gluteal Cutaneous Branches of the Small Sciatic Nerve.—The gluteal cutaneous branches of the small sciatic nerve are usually two or three in number. They turn upwards round the lower border of the gluteus maximus muscle external to the ischial tuberosity, to supply the skin over the lower and outer part of the buttock. They are usually accompanied by some small twigs from the sciatic artery.

The Perforating Cutaneous Nerve of the Sacral Plexus.—This nerve arises, most frequently, from the second and third nerves of the sacral plexus. It passes backwards through the great sacro-sciatic ligament, and, turning upwards round the lower border of the gluteus maximus muscle internal to the ischial tuberosity, supplies the skin over the inner and lower part of that muscle.

The Deep Fascia.—The deep fascia of the buttock is part of the fascia lata of the thigh. It is very strong, and is attached above to the iliac crest, and internally to the sacrum and coccyx.

The deep fascia splits to enclose the gluteus maximus, and in front of that muscle, where it covers the anterior part

of the gluteus medius, the fascia is very strong and dense, and of a glistening, pearly white colour.

That portion of the deep fascia which lies superficial to the gluteus maximus is very much weaker and thinner than elsewhere.

The Gluteus Maximus Muscle.—This muscle is the most superficial and the largest muscle of the buttock. It extends from the pelvis to the upper part of the femur.

Origin.—From the posterior fourth of the iliac crest and the rough surface of the dorsum ilii, between the crest and the superior curved line.

From the back of the last two pieces of the sacrum and the first three pieces of the coccyx.

From the great sacro-sciatic ligament and the aponeurosis of the erector spinæ between the sacrum and the ilium.

From the fascia covering the muscle.

Insertion.—The muscular fibres pass downwards and outwards to be inserted into the gluteal ridge of the femur and into the fascia lata of the thigh. The deep fibres of the lower half of the muscle are alone inserted into the gluteal ridge, the remaining three-fourths being inserted into the fascia.

Nerve Supply.—The inferior gluteal nerve from the sacral plexus.

Action.—The muscle is a powerful extensor of the hip-joint, as in rising from the sitting posture or in ascending stairs. It also assists in rotating the thigh outwards.

Relations.—Superficially, the muscle is covered by the deep fascia and the various cutaneous nerves already described.

The deep relations of the muscle are very important. They may be classified in three groups, as follows:—

An inner group, in front of the origin of the muscle. In this group there are parts of the ilium, sacrum, and coccyx. The ischial tuberosity, with the origins of the hamstring muscles, and the great sacro-sciatic ligament.

An outer group, in front of the insertion of the muscle. In this group there are the upper end of the femur and the

great trochanter. The origin of the vastus externus. Two bursæ, one between the gluteus maximus and the great trochanter, and the other between the muscle and the vastus externus.

An intermediate group. This group is exceedingly important, and must be carefully studied, as it affords the key to the correct appreciation of the anatomy of the buttock.

It comprises five muscles, and four intermuscular spaces transmitting certain structures. These muscles, with the intermuscular spaces and the structures transmitted, are, from above downwards, as follows:—

1. *The gluteus medius muscle.*

The first intermuscular space, transmitting—

The gluteal artery and the superior gluteal nerve.

2. *The pyriformis muscle.*

The second intermuscular space, transmitting two arteries and three pairs of nerves, as follows:—

The sciatic and internal pudic arteries.

The great and small sciatic nerves.

The nerves to the obturator internus and quadratus femoris muscles.

The inferior gluteal and the pudic nerves.

3. *The tricipital tendon*, composed of the tendon of the obturator internus muscle and the two gemelli muscles.

The third intermuscular space, transmitting—

The ascending terminal branch of the internal circumflex artery. The tendon of the obturator externus muscle is also found in this space.

4. *The quadratus femoris muscle.*

The fourth intermuscular space, transmitting the transverse terminal branch of the internal circumflex artery.

5. *The adductor magnus muscle.*

The Gluteus Medius Muscle.—*Origin.*—This muscle arises from the dorsum ilii, between the middle curved line on the one hand and the superior curved line and the iliac crest on the other, and also from the fascia covering the muscle.

Insertion.—The muscular fibres converge towards the great trochanter, to be inserted into an oblique ridge running downwards and forwards on the outer surface of the great trochanter.

Nerve Supply.—The upper division of the superior gluteal nerve from the sacral plexus.

Action.—Its principal action is extension of the hip. Its anterior fibres also assist in rotating the thigh inwards, whilst its posterior fibres assist in rotating outwards; the whole muscle may also abduct the limb.

The Piriformis Muscle.—This is a flattened and triangular muscle which extends from the sacrum to the great trochanter.

Origin.—The muscle arises by three fleshy slips from the pelvic surfaces of the second, third, and fourth pieces of the sacrum, between and external to the anterior sacral foramina.

Some fibres also arise from the anterior surface of the great sacro-sciatic ligament and from the highest part of the great sacro-sciatic foramen.

Insertion.—The muscle passes out of the pelvis through the great sacro-sciatic foramen, to be inserted by a rounded tendon into the middle of the superior border of the great trochanter of the femur.

Nerve Supply.—Twigs from the sacral plexus.

Action.—This muscle abducts the thigh, and also assists in rotating it outwards and in extending the limb.

Extrapelvic Relations.—Along the upper border of the muscle there is the lower border of the gluteus medius muscle, with the superior gluteal nerve and the gluteal artery between the two muscles.

Along the lower border of the muscle there is the superior gemellus, and the various structures which make their appearance in the second intermuscular space.

Superficial to the muscle is the gluteus maximus, whilst the gluteus minimus lies deeper than the piriformis.

The Superior Gemellus Muscle.—*Origin.*—This muscle, usually smaller than the gemellus inferior, arises from the outer and lower part of the ischial spine.

Insertion.—Into the tendon of the obturator internus muscle.

Nerve Supply.—The nerve to the obturator internus.

Action.—An external rotator of the hip.

The Inferior Gemellus Muscle.—*Origin.*—From the upper part of the ischial tuberosity.

Insertion.—Into the tendon of the obturator internus muscle.

Nerve Supply.—The nerve to the quadratus femoris.

Action.—An external rotator of the hip.

The Obturator Internus Muscle.—This is a flattened muscle situated on the intrapelvic surface of the obturator membrane, and extending from thence to the great trochanter of the femur.

Origin.—The muscle arises from the internal or intrapelvic surface of the obturator membrane, from the internal surface of the descending ramus of the pubis, from the internal surface of the body and ascending ramus of the ischium, and, lastly, from that quadrilateral surface of the os innominatum which is situated between the ilio-pectineal line, the obturator foramen, and the ischial spine.

Insertion.—From this extensive origin the muscular fibres converge upon the small sacro-sciatic foramen, through which the muscle leaves the pelvis. Turning round the trochlear surface of the ischium, the tendon of the muscle suddenly changes its direction, and, now passing outwards, is inserted along with the gemelli muscles into an impression on the antero-internal portion of the superior border of the great trochanter of the femur, just in front of the insertion of the pyriformis muscle.

Nerve Supply.—The nerve to the obturator internus from the sacral plexus.

Action.—A powerful external rotator of the hip.

Extrapelvic Relations.—The extrapelvic portion of this muscle is formed by its tendon, which is seen in the dissection of the buttock. With the closely associated gemelli muscles it forms the tricipital tendon already referred to. This tricipital tendon rests upon the ischium and the capsule of the hip-joint; its posterior surface is covered by the great

sacro-sciatic ligament, the sciatic vessels and nerves, and the gluteus maximus muscle.

The Quadratus Femoris Muscle.—*Origin.*—From the outer border of the ischial tuberosity.

Insertion.—Into the quadrate tubercle, and the back of the femur, as low down as the level of the small trochanter.

Nerve Supply.—The nerve to the quadratus femoris from the sacral plexus. This nerve leaves the pelvis below the piriformis, and runs down to its muscle, in front of the great sciatic nerve and the tricipital tendon, and between these structures and the bone. It is accompanied by a small muscular branch from the sciatic artery.

Action.—A powerful external rotator of the thigh.

The Gluteus Minimus Muscle.—*Origin.*—This muscle, which is concealed by the gluteus medius and the piriformis muscles, arises from the dorsum ilii, between the middle and inferior curved lines.

Insertion.—Into an oblique impression on the front of the great trochanter of the femur.

Nerve Supply.—The lower division of the superior gluteal nerve.

Action.—An abductor of the hip-joint.

Relations.—The deep surface of this muscle is in contact with the dorsum ilii, the capsular ligament of the hip-joint, and with the reflected tendon of the rectus femoris muscle.

The Gluteal Artery.—This vessel arises within the pelvis. It is the largest terminal branch of the internal iliac artery. It enters the buttock through the great sacro-sciatic foramen above the piriformis, and divides, between that muscle and the gluteus medius, into a superficial and a deep division.

The superficial division passes backwards to supply the gluteus maximus muscle. It anastomoses with the sciatic and posterior branches of the lateral sacral arteries.

The deep division subdivides into an upper and a lower branch, both of which run forwards between the gluteus medius and minimus muscles.

The upper branch follows the middle curved line of the

ilium, supplies the adjacent muscles, and anastomoses with the ascending branch of the external circumflex artery.

The lower branch runs along the inferior curved line, from which it is separated by the gluteus minimus muscle. It supplies the gluteal muscles, between which it is placed, and the hip-joint. This part of the artery anastomoses with the external circumflex and sciatic arteries.

The Sciatic Artery.—This vessel also arises within the pelvis, from the anterior division of the internal iliac artery. It enters the buttock through the great sacro-sciatic foramen below the pyriformis. It then runs downwards, covered by the gluteus maximus, and resting upon the obturator internus and gemelli muscles.

At the lower border of the gluteus maximus the vessel gives off numerous cutaneous branches, and becoming, in consequence, suddenly much reduced in size, it is continued onwards as a small vessel, which accompanies the small sciatic nerve to supply the skin of the back of the thigh.

Branches.—*The coccygeal artery* pierces the great sacro-sciatic ligament, and is distributed to the gluteus maximus muscle, and the skin over the sacrum and coccyx.

The arteria comes nervi ischiadici enters the great sciatic nerve, which it supplies.

The anastomotie artery runs outwards towards the hollow on the inner side of the great trochanter. It supplies the external rotator muscles and the hip-joint, anastomosing with the gluteal artery, the ascending branch of the internal circumflex, and with the first perforating arteries.

Muscular branches are given off to the various muscles, one of these branches accompanying the nerve to the quadratus femoris muscle.

Cutaneous branches as mentioned above.

The Internal Pudic Artery.—This vessel, also a branch of the internal iliac artery within the pelvis, is now only seen in that part of its course where it is crossing the apex of the ischial spine.

In the buttock it is seen, after it has emerged from the pelvis through the great sacro-sciatic foramen, crossing the

apex of the ischial spine to leave the buttock through the small sacro-sciatic foramen.

The artery passes onwards to supply the perineum and the external genitals. As the artery is crossing the apex of the ischial spine it has on either side of it the *venæ comites*, and on the inner side, lying on the small sacro-sciatic ligament, is the pudic nerve; whilst on the outer side of the vessel, and resting upon the base of the ischial spine, is the nerve to the obturator internus muscle.

The Gluteal, Sciatic, and Internal Pudic Veins.—The veins corresponding to the three vessels described re-enter the pelvis, with their respective arteries, to terminate in the internal iliac vein.

The Great Sciatic Nerve.—This, the largest nerve in the body, is the continuation downwards of the main part of the sacral plexus. It arises in the pelvis and enters the buttock through the great sacro-sciatic foramen below the pyriformis. The nerve extends down to about the middle of the thigh, where it terminates by dividing into the external and internal popliteal nerves.

In this course the nerve rests upon, or has in front of it, the tricipital tendon of the obturator internus and gemelli muscles, the quadratus femoris, and the adductor magnus. It is covered posteriorly by the gluteus maximus muscle and the long head of the biceps flexor cruris.

The nerve lies rather internal to the mid-point between the ischial tuberosity and the great trochanter of the femur. It is most superficial just below the gluteal fold.

Branches.—The great sciatic does not supply any of the muscles of the buttock, but gives off *muscular branches to the hamstring muscles* on the back of the thigh, that is, to the semitendinosus, semimembranosus, and biceps flexor cruris muscles. It also gives off a branch to the inner part of the adductor magnus muscle.

The Small Sciatic Nerve.—This nerve is a purely sensory nerve. It arises within the pelvis from the back of the first three sacral nerves, and enters the buttock through the great sacro-sciatic foramen, below the pyriformis.

The nerve runs down the back of the thigh, resting upon

the great sciatic nerve under cover of the deep fascia, until it reaches the knee, just beyond which it pierces the fascia, to end in the skin of the back of the leg. In the upper part of its course the nerve is accompanied by the sciatic artery.

Branches.—*Gluteal cutaneous branches* are given off to the skin of the buttock.

The Long Pudendal Nerve, or the Nerve of Soemmerring.—This nerve, the only named branch given off by the small sciatic, turns inwards below, and in front of the ischial tuberosity, to supply the skin of the upper and inner parts of the thigh and scrotum.

The femoral cutaneous branches supply the skin on the back of the thigh, principally on its inner side.

The Superior Gluteal Nerve.—This nerve arises within the pelvis from the back of the lumbo-sacral cord and the first sacral nerve. It enters the buttock through the great sacro-sciatic foramen above the pyriformis muscle, and therefore in the first intermuscular space.

The nerve immediately divides into two branches, *the upper* of which accompanies the upper branch of the deep division of the gluteal artery, and supplies the gluteus medius muscle; *the lower* branch accompanies the lower branch from the deep division of the gluteal artery, and supplies the gluteus minimus and tensor fasciæ femoris muscles, in the latter of which it ends.

The Inferior Gluteal Nerve.—This nerve arises from the lumbo-sacral cord and the first and second sacral nerves. It enters the buttock through the great sacro-sciatic foramen, below the pyriformis, and, breaking up into a number of branches which pass upwards and downwards, enters the deep surface of the gluteus maximus muscle midway between its origin and its insertion, supplying the muscle.

The Pudic Nerve.—This nerve is only seen in the buttock where it is winding over the small sacro-sciatic ligament, just internal to the internal pudic artery. It is distributed with the artery to the perineum and the external genitals.

The Nerve to the Obturator Internus Muscle.—This nerve arises in the pelvis from the fifth lumbar and first

two sacral nerves. It appears in the buttock in the second intermuscular space, between the great sciatic nerve and the pudic nerve, and, crossing the base of the ischial spine just to the outer side of the internal pudic artery, it disappears through the small sacro-sciatic foramen, to reach the intrapelvic or muscular portion of the obturator internus muscle, which it supplies. Just as the nerve is crossing the ischial spine it gives off its branch to the superior gemellus.

The Nerve to the Quadratus Femoris Muscle.—This nerve arises from the lumbo-sacral cord and the first sacral nerve, and enters the buttock through the great sacro-sciatic foramen.

In the buttock the nerve is at first concealed by the great sciatic nerve, as it lies in front of that structure, between it and the ischium; it then passes downwards between the capsule of the hip-joint in front; and the superior gemellus, the tendon of the obturator internus, the inferior gemellus, and the quadratus femoris muscles behind.

The nerve to the quadratus femoris supplies the quadratus femoris and inferior gemellus muscles, and the hip-joint. It is accompanied by a muscular branch from the sciatic artery.

II. THE POPLITEAL SPACE

Definition.—The popliteal space or ham is the somewhat diamond-shaped space situated behind the knee.

Shape.—The popliteal space is diamond-shaped, with lateral boundaries, a roof, and a floor. When dissected it extends upwards along the lower third of the femur, and downwards along the upper sixth of the tibia.

Boundaries.—*Above, and to the outer side.*—The tendon of the biceps flexor cruris muscle.

Above, and to the inner side.—The tendons of the semitendinosus and semimembranosus muscles.

Below, and to the inner side.—The inner head of the gastrocnemius muscle.

Below, and to the outer side.—The outer head of the gastrocnemius, and plantaris muscles.

The Roof.—The roof is formed by the deep, or the popliteal fascia.

The Floor.—The floor is formed, from above downwards, by the popliteal surface of the femur, the posterior ligament of the knee-joint, and the popliteus muscle covered by its fascia.

The Superficial Fascia.—The superficial fascia over the popliteal space contains the undermentioned structures:—

(a) *A Minute Branch from the Small Sciatic Nerve.*—This passes downwards along the middle line of the space. It supplies the skin over the space.

(b) *The Termination of the Small Sciatic Nerve.*—This nerve runs downwards along the middle of the space concealed by the deep fascia. At the lower angle of the space the nerve pierces the deep fascia to become cutaneous. It passes onwards in the superficial fascia, to terminate in the skin over the back of the calf. After piercing the deep fascia the nerve accompanies the external saphenous vein.

(c) *The External or Short Saphenous Vein.*—This vein ascends in the middle line of the back of the leg. At the lower part of the popliteal space the vein pierces the deep fascia to terminate in the popliteal vein.

The Deep Fascia, or the Popliteal Fascia.—The popliteal fascia forms the roof of the popliteal space. Although comparatively thin this fascia is very strong. It consists principally of fibres stretching transversely from side to side across the popliteal space. These fibres are attached to the tendons of the muscles which bound the space laterally. Above, the popliteal fascia is continuous with the fascia lata of the thigh. It is pierced near the lower angle of the space by the small sciatic nerve and by the external or short saphenous vein.

Contents of the Popliteal Space.—These are as follows:—

The small sciatic nerve.

The internal popliteal nerve.

The external popliteal nerve.

The popliteal artery and its branches.

The popliteal vein and its tributaries.

The termination of the external or short saphenous vein.
The occasional geniculate branch of the obturator nerve.
Lymphatics.
Fat.

The Small Sciatic Nerve.—As just stated, this nerve descends along the middle of the popliteal space, and becomes cutaneous just below the knee-joint by piercing the deep fascia. It usually accompanies the external or short saphenous vein, and supplies the skin of the calf.

The Internal Popliteal Nerve.—This nerve commences about the middle of the back of the thigh by the bifurcation of the great sciatic nerve into internal and external popliteal nerves. It passes down through the popliteal space to terminate opposite the lower border of the popliteus muscle, by becoming directly continuous with the posterior tibial nerve.

In this course the nerve lies behind or superficial to both the popliteal artery and vein, and crosses both structures from above downwards and from without inwards.

The internal popliteal nerve differs from the external popliteal nerve in the following respects:—The internal popliteal nerve is larger than the external and runs more nearly vertically. It also furnishes muscular branches, which the external does not.

Branches.—The branches of the internal popliteal nerve may be classified as follows:—

Cutaneous branch.

The ramus communicans tibialis.

Articular branches.

Upper internal articular.

Lower internal articular.

Azygos articular.

Muscular branches.

To the gastrocnemius muscle.

To the plantaris muscle.

To the soleus muscle.

To the popliteus muscle.

The cutaneous branch, or the ramus communicans tibialis, passes downwards, and joins the ramus communicans fibularis

from the external popliteal nerve to form the external or short saphenous nerve.

The ramus communicans tibialis descends in the interval between the two heads of the gastrocnemius to about the middle of the back of the leg, where it pierces the deep fascia. It is frequently accompanied by one of the superficial sural arteries.

The articular branches are usually three in number, but may occasionally be only two in number. They accompany the upper and lower internal articular arteries, and the azygos artery. They arise from the upper part of the trunk of the internal popliteal nerve.

Muscular branches are given off to all the superficial muscles on the back of the leg; that is, to the gastrocnemius, soleus, and plantaris muscles, and, in addition, to one of the deep muscles of the same region, the popliteus.

The nerves to the *gastrocnemius* are usually two in number, one to each head of the muscle.

The nerve to the *plantaris* is a small branch, which arises either from the trunk of the internal popliteal, or, just as frequently, from the nerve to the outer head of the *gastrocnemius*.

The nerve to the *soleus* is a large branch which enters the muscle at the upper part of its posterior surface.

The nerve to the *popliteus* is a long slender branch, which descends on the outer side of the popliteal vessels to the lower border of the popliteus muscle. It then passes upwards in front of the muscle, and supplies it on its anterior or deep surface. This small nerve, in addition to supplying the popliteus muscle, also gives off minute filaments to the superior tibio-fibular articulation, to the tibia, and to the interosseous membrane.

The External Popliteal Nerve.—This nerve commences about the middle of the back of the thigh by the bifurcation of the great sciatic nerve into internal and external popliteal nerves. From this origin the external popliteal nerve runs downwards and outwards close to the biceps flexor cruris muscle, and so gradually passes out of the popliteal space.

The nerve crosses the outer head of the *gastrocnemius*,

below the head of the fibula, and, turning round the neck of that bone, terminates in the substance of the peroneus longus muscle by dividing into the anterior tibial and musculo-cutaneous nerves.

Branches.—The branches of the external popliteal nerve may be classified as follows:—

Cutaneous branches—

The ramus communicans fibularis.

The lateral cutaneous branches of the leg.

Articular branches—

Upper external articular.

Lower external articular.

The ramus communicans fibularis pierces the deep fascia very shortly after its origin, and, descending behind the outer head of the gastrocnemius, joins the ramus communicans tibialis to form the external or short saphenous nerve.

The lateral cutaneous branches supply the outer side of the leg in its lower and middle parts.

The articular branches accompany the upper and lower external articular arteries, and supply the knee-joint, and the superior tibio-fibular articulation.

The Popliteal Artery.—This vessel commences at the opening in the adductor magnus muscle, as the direct continuation of the femoral artery. It passes downwards and slightly outwards to the middle of the back of the knee-joint, and then directly downwards, to terminate opposite the lower border of the popliteus muscle, on a level with the most dependent point of the tubercle of the tibia, by dividing into anterior and posterior tibial arteries.

Relations.—In front.—In front of the artery, that is, deeper than the vessel, there are, from above downwards, the popliteal surface of the femur, from which the vessel is separated by a quantity of fat; the posterior ligament of the knee-joint, and the popliteus muscle covered by its fascia.

Behind.—The artery is covered posteriorly, at its origin, by the semimembranosus muscle. It next lies in the popliteal space with no muscular structures behind it; whilst lastly, near its termination, it is covered by the gastroc-

nemius and soleus muscles, and is crossed by the plantaris muscle.

Relations of the Popliteal Artery, Vein, and Nerve.—The popliteal artery is the deepest or the most anterior of these three structures, the vein is intermediate, and the internal popliteal nerve is the most posterior or the most superficial of the three structures.

The popliteal vein passes vertically upwards, and crosses the artery from within outwards.

The internal popliteal nerve crosses both artery and vein from above downwards, and from without inwards.

These relations should be carefully noted, inasmuch as they serve to explain the nervous phenomena and the œdema of the leg which so frequently accompany aneurism of the popliteal artery.

Branches.—The branches of the popliteal artery may be classified as follows:—

Muscular branches.

An upper set.

A lower set, or the sural arteries.

Cutaneous branches, or the superficial sural arteries.

Articular branches.

Upper external and internal articular arteries.

Lower external and internal articular arteries.

Azygos articular artery.

Muscular Branches.—The muscular branches are subdivided into an upper and a lower group.

The *upper* muscular branches, three or four in number, lie above the knee-joint, and supply the hamstring muscles.

The *lower* muscular branches, or the *sural* arteries, are usually two in number and of large size. They enter the two heads of the gastrocnemius muscle, and supply that muscle, the plantaris, and the upper part of the soleus.

The Cutaneous or Superficial Sural Arteries.—These are derived somewhat irregularly, either from the sural arteries, or from the popliteal artery itself. They supply the skin for some distance down the back of the leg.

The Articular Branches.—These vessels are five in number, two paired, and a single unpaired or azygos artery.

The paired branches pass off from the main trunk nearly at a right angle, two being above the condyles of the femur, and two below the knee-joint, whilst the fifth passes directly forwards into the centre of the joint.

Four of these five articular branches have an important relation to two other structures.

The *superior external articular* artery passes outwards above the external condyle of the femur, under cover of the tendon of the biceps flexor cruris.

The *superior internal articular* artery passes inwards above the internal condyle of the femur, under cover of the tendon of the adductor magnus muscle.

The *inferior external articular* artery passes outwards above the head of the fibula, under cover of the external lateral ligament of the knee-joint.

The *inferior internal articular* artery passes downwards and inwards below the internal tuberosity of the tibia, under cover of the internal lateral ligament of the knee-joint.

The *azygos articular* artery passes directly forwards, and pierces the posterior ligament of the knee-joint, accompanied by the azygos vein, an articular filament from the internal popliteal nerve, and the geniculate branch of the obturator nerve.

The Arterial Anastomosis around the Knee-Joint.—

The various articular arteries take part in an arterial anastomosis round the knee-joint. This anastomosis is taken part in by seven vessels, as follows:—

The four articular arteries, from the popliteal.

The anastomotica magna, from the femoral artery in Hunter's canal.

The anterior tibial recurrent, from the anterior tibial artery.

The descending branch of the external circumflex, from the profunda femoris artery.

The various vessels mentioned above form a series of transverse and longitudinal arches across the front and down the sides of the knee in the following manner:—

The *superior external articular* artery anastomoses above, with the descending branch of the external circumflex; below,

with the inferior external articular artery. This artery also forms a transverse anastomosis above the patella with the superior internal articular artery, and with the deep division of the anastomotica magna.

The inferior external articular artery anastomoses above, with the superior external articular artery; below, with the anterior tibial recurrent artery. It also forms a transverse anastomosis below the patella with the inferior internal articular artery.

The superior internal articular artery anastomoses above, with the deep division of the anastomotica magna; below, with the inferior internal articular artery. It also forms a transverse anastomosis above the patella, with the superior external articular artery.

The inferior internal articular artery anastomoses above, with first, the superficial division of the anastomotica magna, and secondly, with the superior internal articular artery. It also anastomoses below the patella with the inferior external articular artery.

The Popliteal Vein.—This vein commences at the lower border of the popliteus muscle, by the union of the four venæ comites of the anterior and posterior tibial arteries. The vein passes vertically upwards through the popliteal space, to terminate at the opening in the adductor magnus muscle, by becoming directly continuous with the femoral vein.

In this course the vein lies throughout posterior to the artery, between it and the internal popliteal nerve. The vein crosses the artery from below upwards, and from within outwards.

Tributaries.—The tributaries correspond to the branches of the artery. The vein also receives, in addition, the short or external saphenous vein.

The Geniculate Branch of the Obturator Nerve.—This nerve enters the popliteal space by piercing the adductor magnus muscle, close to the opening for the popliteal artery. It lies on the inner side of the popliteal artery as far as the back of the knee-joint, which it then enters by piercing the posterior ligament. This nerve is often absent. The referred pain in hip-joint disease is therefore, contrary to the customary

teaching, more frequently due to the anterior crural nerve than to the obturator nerve.

The Lymphatic Glands.—These are usually about five in number. They are placed along the line of the great vessels, and when enlarged may be mistaken for aneurism or other popliteal tumour.

III. THE BACK OF THE THIGH

This region comprises the three muscles known as the hamstring muscles. They are:—

The biceps flexor cruris.

The semitendinosus.

The semimembranosus.

All these muscles are supplied by the great sciatic nerve.

The Biceps Flexor Cruris Muscle.—This is a long muscle situated at the outer part of the back of the thigh, and stretching from the ischium to the fibula. As its name implies, it consists of two heads—a long and a short head.

Origin.—The *long* head arises by a tendon common to this muscle and the semitendinosus, from the upper and inner facet of the ischial tuberosity, and slightly from the great sacro-sciatic ligament.

The *short* head arises from the whole length of the outer lip of the linea aspera, from the upper half of the external supracondylar ridge, and from the adjacent external intermuscular septum.

Insertion.—The tendon passes downwards and outwards, to be inserted principally into the styloid process on the head of the fibula, by means of two portions which split to enclose the external lateral ligament of the knee-joint.

The tendon is also inserted into the deep fascia of the leg, and into the external tuberosity of the tibia by means of two aponeurotic slips.

Nerve Supply.—The great sciatic nerve.

Action.—The biceps flexor cruris, like the other hamstring muscles, is a *primary* flexor of the knee-joint. It also rotates the knee outwards after that joint is flexed, and acts upon the hip-joint as a powerful extensor.

The Semitendinosus Muscle.—This muscle lies superficially on the inner side of the back of the thigh.

Origin.—The semitendinosus arises in common with the long head of the biceps from the upper and inner facet of the ischial tuberosity, and also from the upper three inches of the tendinous portion of the long head of the biceps on its inner side.

Insertion.—In the lower third of the thigh the muscle terminates in a long, round, and slender tendon, which, after running down on the semimembranosus, curves forwards, to be inserted into the upper part of the internal surface of the tibia, below the insertion of the gracilis, and behind that of the sartorius. It also sends a fascial process to the fascia of the leg.

Nerve Supply.—The great sciatic nerve.

Action.—A *primary* flexor of the knee, and a rotator inwards of that joint after it is flexed. Like the biceps, it also acts as a powerful extensor of the hip-joint.

The Semimembranosus Muscle.—This muscle is situated immediately in front of the preceding muscle.

Origin.—By a flattened tendon from the upper and outer facet of the ischial tuberosity. This tendon is grooved posteriorly by the tendon of origin common to the biceps and semitendinosus muscles.

The tendon of origin of the semimembranosus is continued along the outer border of the muscle for about three-fourths of its length. From this tendon of origin the fleshy fibres pass downwards and inwards to the tendon of insertion.

Insertion.—The tendon of insertion appears about the middle of the back of the thigh, and runs down the inner border of the muscle, to be inserted principally into the groove on the back of the internal tuberosity of the tibia. The tendon has, however, other and additional insertions, as follows:—

A tendinous expansion is sent upwards and outwards, to be inserted into the posterior ligament of the knee-joint.

A second expansion is sent downwards, to be inserted into the fascia covering the popliteus muscle.

Lastly, some few fibres are inserted into the internal lateral ligament of the knee-joint.

Nerve Supply.—The great sciatic nerve.

Action.—The same as the semitendinosus, which see.

The Great Sciatic Nerve.—This nerve, which supplies the hamstring muscles, has been fully described on page 88.

The Perforating Arteries. (See page 121.)

IV. THE FRONT OF THE THIGH—SUPERFICIAL DISSECTION

The Superficial Fascia. — The superficial fascia on the front of the thigh is similar to that found in other regions.

It passes upwards superficial to Poupart's ligament to become continuous with the *fascia of Camper* of the abdomen.

Internally, it becomes continuous with the unnamed fatty layer of the superficial fascia of the perineum.

In the region of the deficiency in the deep fascia, known as the saphenous opening, the superficial fascia is strengthened by a membranous substratum of condensed areolar tissue, termed the *cribriform fascia*.

The cribriform fascia is only found in the region of the saphenous opening, to the margins of which it is closely attached. It serves to compensate, in some measure, for the weakness produced by this opening in the deep fascia; and, as it is pierced by numerous small vessels and lymphatics, it is termed the cribriform fascia.

The Cutaneous Nerves.—The cutaneous nerves on the front of the thigh are six in number, and are derived from two sources, as follows:—

From the lumbar plexus—

The ilio-inguinal nerve.

The crural branch of the genito-crural nerve.

The external cutaneous nerve.

From the anterior crural nerve—

The middle cutaneous nerve.

The internal cutaneous nerve.

The internal or long saphenous nerve.

The Ilio-Inguinal Nerve.—This nerve is derived from the first lumbar nerve. It passes through the external abdominal ring on the outer side of the spermatic cord, or of the round ligament of the uterus in the female. It supplies the skin of the scrotum, or the labium pudendi in the female, and the adjacent part of the thigh internal to the saphenous vein.

The Crural Branch of the Genito-Crural Nerve.—This nerve is derived from the first and second lumbar nerves. It pierces the fascia lata of the thigh just below Poupart's ligament and on the outer side of the femoral artery. It supplies the skin on the front of the thigh as far as its middle.

The External Cutaneous Nerve.—This nerve is derived from the second and third lumbar nerves. It enters the thigh just internal to the anterior superior iliac spine, and behind Poupart's ligament. After running downwards in a tunnel of deep fascia for a distance of about two inches, it divides into an anterior and a posterior branch.

The *posterior* branch pierces the fascia lata, and turns backwards to supply the skin of the buttock and outer side of the thigh.

The *anterior* branch is the continuation of the nerve. It pierces the fascia four inches below Poupart's ligament, and supplies the skin on the outer part of the front of the thigh as low as the knee, where it usually assists in the formation of the patellar plexus.

The Middle Cutaneous Nerve.—This nerve, derived from the anterior crural nerve, either pierces the fascia as a single trunk, or in two separate parts which make their appearance about three or four inches below Poupart's ligament.

Its branches descend on the front and inner sides of the thigh as low as the patella, and take part in the formation of the patellar plexus. The more external of the two branches into which this nerve divides usually pierces the sartorius muscle before becoming subcutaneous.

The Internal Cutaneous Nerve.—This nerve, derived from the anterior crural nerve, divides into two branches which pierce the fascia lata of the thigh at different places. Before its division, the main trunk of the nerve descends obliquely across the upper part of the femoral artery, and then divides into anterior and posterior branches.

The *anterior* branch runs downwards, and pierces the deep fascia at the lower part of the thigh. It supplies the skin over the inner side of the thigh and the knee-joint, and takes part in the formation of the patellar plexus.

The *posterior* branch descends along the inner side of the sartorius muscle, and perforates the deep fascia at the inner side of the knee, immediately behind the long saphenous nerve. It supplies the lower part of the thigh and the upper part of the leg on their inner sides.

The Internal or Long Saphenous Nerve.—This, the largest branch given off by the anterior crural nerve, arises from its posterior division. In its course through the thigh it is deeply situated, accompanying the femoral vessels.

It becomes subcutaneous by piercing the deep fascia just below, and to the inner side of the knee, between the tendons of the sartorius and gracilis muscles.

It gives off a *patellar* branch which pierces the sartorius muscle and the fascia lata on the inner side of the knee, and which then turns outwards and forwards below the level of the patella to join the patellar plexus.

The internal saphenous nerve is then continued onwards, down the inner side of the leg, as far as the tubercle of the scaphoid bone on the inner side of the foot.

Nerve Plexuses.—There are two nerve plexuses formed on the front of the thigh in connection with the foregoing nerves—

A *patellar plexus* lying in front of the patella, and formed by the external, middle, and internal cutaneous nerves, and the internal saphenous nerve.

A *subsartorial plexus* situated on the inner side of the thigh, and formed by the middle and internal cutaneous nerves, the internal saphenous, and obturator nerves.

The Cutaneous Vessels.—The small arteries found at the upper part of the thigh are branches of the common femoral artery. They pierce the deep fascia, and supply the skin and glands.

The Superficial External Pudic Artery comes forwards through the cribriform fascia, and then passes inwards in front of the spermatic cord to supply the skin of the penis and scrotum.

The Superficial Epigastric Artery runs upwards on the abdominal wall, anastomosing, in the neighbourhood of the umbilicus, with the superior epigastric artery from the internal mammary artery.

The Superficial Circumflex Iliac Artery runs upwards and outwards towards the iliac crest and supplies the skin. It is the smallest of the three arteries.

Each of the above vessels is accompanied by a corresponding vein, which terminates in the internal or long saphenous vein.

The Internal or Long Saphenous Vein.—This is the longest vein in the body. It extends from the foot to the upper part of the thigh. In the present part of its course it extends from the inner side of the knee along the inner side and front of the thigh to just below the inner end of Poupart's ligament, where it pierces the deep fascia at the saphenous opening, to terminate in the femoral vein.

Tributaries.—This vein receives many cutaneous tributaries; two large unnamed tributaries on the front of the thigh, and tributaries corresponding to the three subcutaneous arteries already mentioned.

This vein is peculiarly liable to become varicose. The anatomical reasons for this peculiarity are the great length of the vein; the fact that in the greater part of its course it lies superficial to the deep fascia, and is therefore unsupported by muscles; and the influence of gravity, during the erect posture, on the long column of blood sustained in the vein.

The Superficial Lymphatic Glands.—These are arranged in two groups—a vertical or femoral group, and a horizontal or inguinal group.

The femoral group are situated along the line of the internal saphenous vein, and drain the lower limb. These glands are apt to become enlarged in poisoned wounds of the foot.

The inguinal group lie above and parallel with Poupart's ligament. They drain the lymphatics of the penis and the surface of the abdomen. They become enlarged, most frequently from venereal diseases.

The Deep Fascia, or the Fascia Lata.—The deep fascia, or *the fascia lata*, is a very strong aponeurotic membrane, surrounding the limb, for which it forms a species of sheath.

Above, the deep fascia is attached to the back of the sacrum and coccyx, the crest of the ilium, Poupart's ligament, the body and rami of the pubis, the rami and tuberosity of the ischium, and the great sacro-sciatic ligament.

The thickness of the fascia lata varies in different positions. Externally, it is especially thick, and forms a strong band termed *the ilio-tibial band*. This ilio-tibial band extends from the external tuberosity of the tibia and the head of the fibula below, to the ilium above. It assists in keeping the knee-joint straight in the erect attitude. Into this portion of the fascia lata are inserted the fibres of the tensor fasciæ femoris muscle, and three-fourths of those of the gluteus maximus.

The deep fascia sends several processes, between the various muscles, to the femur; these are termed *the inter-muscular septa*, and are described later. (See page 118.)

There are numerous apertures in the deep fascia, for the transmission of the various vessels and nerves; one of these apertures transmits the internal saphenous vein, and, being much larger and much more important than any of the other apertures in the fascia, it is specially named and described under the term of the *saphenous opening*. This aperture must be carefully studied, as it is through this aperture that a femoral hernia passes forwards from the crural canal.

The Saphenous Opening.—The saphenous opening is an

aperture in the fascia lata, one and a half inches long, and half an inch wide, situated at the upper and inner part of the front of the thigh, just below the inner end of Poupart's ligament.

It transmits the internal or long saphenous vein, lymphatics, and some small vessels, and is covered by the cribriform fascia, which is firmly attached to its margins.

The external margin of the saphenous opening is formed by that portion of the deep fascia which is usually termed the *iliac portion* of the fascia lata. It forms a very distinct crescentic edge, which lies immediately in front of the femoral artery, and which is known as the *falciform border*.

This falciform border is continued upwards as the *superior cornu*, to be attached to Gimbernat's ligament.

Inferiorly, the falciform border passes downwards to become continuous with the *inferior cornu*, which lies exactly in the angle between the internal saphenous and femoral veins.

The internal margin of the saphenous opening is ill defined, and, as a margin, can hardly be said to exist. It is formed by the *pubic portion* of the fascia lata, which is receding behind the femoral vessels to become continuous with the pectineal fascia, which is attached to the iliopectineal line just in front of the pectineus muscle.

That portion of the fascia lata which lies immediately external to the saphenous opening is sometimes known as the *iliac portion* of the fascia lata. It is attached above to Poupart's ligament, and forms the falciform border of the opening.

That portion of the fascia lata which lies immediately internal to the saphenous opening is sometimes known as the *pubic portion* of the fascia lata. It recedes behind the femoral vessels, as stated above.

V. SCARPA'S TRIANGLE

Definition and Position.—Scarpa's triangle is the inter-muscular space occupying the upper and inner third of the

front of the thigh, and containing the femoral vessels and the trunk of the anterior crural nerve.

Shape.—Distinctly triangular, with the base uppermost.

Boundaries.—*The base* is above, and is formed by Poupart's ligament.

Externally, it is bounded by the inner edge of the sartorius muscle.

Internally, by the inner edge of the adductor longus muscle.

The Apex is formed by the meeting of the outer and inner boundaries.

The Roof is formed by the deep fascia of the thigh, and, where that is deficient, by the cribriform fascia.

The Floor of Scarpa's triangle is formed entirely by muscles, which are from without inwards—

The iliacus muscle.

The psoas muscle.

The pectineus muscle.

The adductor brevis muscle, but only occasionally.

The adductor longus muscle.

Contents.—These are as follows:—

The femoral artery and its branches.

The femoral vein and its tributaries.

The anterior crural nerve and its branches.

The deep lymphatic vessels and the femoral sheath.

Poupart's Ligament.—This ligament is, in reality, the reflected lower edge of the aponeurosis of the external oblique muscle of the abdomen. It stretches from the anterior superior spine of the ilium to the spine of the pubis. In the natural state of the parts, Poupart's ligament is curved downwards with the convexity towards the thigh, the inner half of the ligament being almost horizontal.

The interval between the concave ilio-pubic margin of the hip-bone and Poupart's ligament is occupied by certain structures passing from the abdomen to the thigh. These structures are invested by special layers of fascia, which thus permit of the division of the space into three compartments—a vascular compartment, an iliac compartment, and a pectineal compartment.

The Vascular Compartment.—This compartment lies between and in front of the other two.

It is bounded in front by the superficial and deep femoral arches, that is, by Poupart's ligament, and the fascia transversalis of the abdomen passing down into the thigh in front of the femoral vessels and behind Poupart's ligament.

The vascular compartment is bounded posteriorly by the continuous fascia iliaca of the abdomen, and the pectineal fascia.

This compartment transmits from without inwards—

The crural branch of the genito-crural nerve.

The femoral artery.

The femoral vein.

Between the femoral vein and the lateral free margin or base of Gimbernat's ligament there is an aperture termed the femoral or crural ring, through which a femoral hernia leaves the abdomen.

The Iliac Compartment.—The iliac compartment lies to the outside of, and behind the vascular compartment.

It is bounded in front by Poupart's ligament, and the fascia iliaca of the abdomen; behind, by the ilium; internally, by the ilio-pectineal intermuscular septum, which separates this compartment from the pectineal compartment.

The iliac compartment transmits the following structures from without inwards:—The external cutaneous nerve, the iliacus muscle, the anterior crural nerve, and the psoas muscle.

The Pectineal Compartment.—The pectineal compartment is merely the blind cul-de-sac which lodges the upper end, or origin, of the pectineus muscle.

It is bounded in front by the pectineal fascia; behind, by the ascending ramus of the pubis. This compartment is closed above by the attachment of the pectineal fascia to the ilio-pectineal line.

Gimbernat's Ligament.—This is a reflection backwards from the inner end of Poupart's ligament to the ilio-pectineal line. It is a triangular structure presenting for examination a base, an apex, an anterior border, a posterior border, a superior surface, and an inferior surface.

The base of the ligament is sharp and free, and forms the internal boundary of the crural ring; hence it has a most important relation to the anatomy of femoral hernia, as it is against this part of the ligament that the hernia most frequently becomes strangulated.

The apex of the ligament is situated at the pubic spine.

The anterior border is attached to Poupart's ligament, whilst the posterior border is attached to one inch of the ilio-pectineal line.

The superior surface looks upwards and slightly inwards, the lower surface looks downwards and slightly outwards.

The Sartorius Muscle.—This is a long ribbon-like muscle, which passes from the ilium to the upper end of the tibia.

Origin.—From the anterior superior spine of the ilium, and from part of the notch below.

Insertion.—The muscle passes first obliquely downwards and inwards, across the front of the thigh, and then almost vertically downwards on the inner side of the thigh, to be inserted into the upper part of the inner surface of the shaft of the tibia, immediately in front of the insertions of the gracilis and semitendinosus muscles.

It also sends an expansion upwards to the capsule of the knee-joint, and another downwards to the fascia of the leg.

Nerve Supply.—The anterior division of the anterior crural nerve.

Action.—The sartorius is a flexor and evertor of the hip-joint, and a flexor and internal rotator of the knee-joint. It has been supposed to be the muscle by means of which a tailor assumes his characteristic attitude in sitting, hence the name of the muscle.

Relations.—The upper part of the internal border of the sartorius forms the outermost boundary of Scarpa's triangle.

The middle third of the muscle lies in the roof of Hunter's canal.

The Adductor Longus Muscle.—This belongs to the adductor group of muscles. (See page 125.)

The Iliacus Muscle.—This muscle arises in the abdomen, and its origin is there described.

Insertion.—The iliacus is inserted principally into the tendon of the psoas muscle. Its outermost fibres are, however, inserted directly into the femur, just in front of and below the small trochanter.

The Psoas Muscle.—This muscle also arises within the abdomen.

Insertion.—By means of a tendon into the small trochanter of the femur.

Action of the Ilio-Psoas Muscle.—The ilio-psoas muscle is a powerful flexor of the hip-joint, acting as a direct antagonist of the gluteus maximus muscle.

It is also stated, by Morris, to be an internal rotator of the hip-joint.

Relations of the Ilio-Psoas Muscle.—On the anterior surface of the ilio-psoas muscle, the anterior crural nerve lies in the interval between the iliacus and the psoas.

Posteriorly, the iliacus rests upon the anterior head of the rectus femoris muscle, and on the capsule of the hip-joint.

Between the tendon of the ilio-psoas and the hip-joint there is very frequently a large bursa, which may communicate with the interior of the joint, and which, if inflamed, may simulate hip-joint disease.

The Pectineus Muscle.—The pectineus is a flat, thin muscle, situated at the upper and inner part of the thigh.

Origin.—From the ilio-pectineal line and from the bone immediately in front of and below that line, between the ilio-pectineal eminence and the pubic spine.

Insertion.—The muscle passes outwards and backwards, to be inserted by a flat tendon into the upper part of the line leading from the small trochanter to the inner lip of the linea aspera of the femur.

Nerve Supply.—The nerve to the pectineus, from the anterior division of the anterior crural nerve.

The muscle may also be supplied by a branch from the anterior division of the obturator nerve.

Action.—The pectineus belongs to the adductor group of muscles, and is therefore *primarily* an adductor of the hip-joint; it also acts as a *secondary* flexor of that joint.

The Femoral Sheath.—This is a special sheath for the

femoral vessels. It is a funnel-shaped structure, about two inches in length, which commences behind the inner half of Poupart's ligament at the deep crural arch.

This sheath is formed by a downward prolongation into the thigh of the fascial lining of the abdomen, and is therefore formed in front by the fascia transversalis, and behind by the continuous fascia iliaca of the abdomen and the pubic portion of the fascia lata of the thigh.

The outer margin of the sheath is vertical, and lies in contact with the femoral artery. It is pierced by the crural branch of the genito-crural nerve.

The inner margin is oblique, and inclines from the lateral free margin, or base of Gimbernat's ligament, downwards and outwards, to come into contact with the femoral vein about half an inch below Poupart's ligament. This margin of the sheath is pierced by lymphatics, superficial vessels, and the internal saphenous vein. It lies behind the saphenous opening.

The femoral sheath is divided by two antero-posterior septa into three compartments. The *outermost* compartment contains the femoral artery and the crural branch of the genito-crural nerve. The *middle* compartment contains the femoral vein and a few lymphatics. The *innermost* compartment contains some fat and lymphatics, and is known as *the crural or femoral canal*. As a femoral hernia descends through this femoral canal, it must be studied with the greatest care. It presents for examination an entrance or crural ring, and the canal itself.

The Crural or Femoral Ring.—The crural ring is the abdominal entrance into the crural canal. It lies immediately to the outer side of the base of Gimbernat's ligament, between that structure and the femoral vein. It is larger in the female than in the male, its lateral diameter being about half an inch. The crural ring has the following boundaries:—

In Front, there are the superficial and deep crural arches, that is, Poupart's ligament, and a specially thickened portion of the fascia transversalis.

Behind, from before backwards, there are the thickened upper portion of the pectineal fascia, the pectineus muscle, and the os pubis.

To the Inner Side, there is the lateral free margin, or base of Gimbernat's ligament.

To the Outer Side, the femoral vein, lying in the middle compartment of the femoral sheath.

On three sides of the ring there are consequently dense, unyielding structures; a femoral hernia, which leaves the abdomen through this ring, is therefore very liable to become strangulated, and requires prompt treatment.

The Crural or Femoral Canal.—The crural or femoral canal is the innermost compartment of the femoral sheath. Its length is not so great as that of the other two compartments of the femoral sheath, as it is not more than half an inch long.

Its upper end, or abdominal entrance, is termed the crural ring and is placed opposite the base of Gimbernat's ligament. It is normally occupied or plugged, as it were, by a portion of the extra-peritoneal fat of the abdomen, to which surgeons usually apply the name *Septum crurale*.

The lower end of the canal is situated opposite the superior cornu of the saphenous opening. It is quite closed and constitutes a blind extremity.

The canal itself thus tapers from above downwards. Its normal contents are fat and lymphatics, but pathologically it may contain part of the intestine, as in the case of a femoral hernia.

The Femoral Artery.—The femoral artery extends over the upper two-thirds of the thigh, lying firstly in Scarpa's triangle, and secondly in Hunter's canal. The femoral artery commences behind Poupart's ligament, as the direct continuation of the external iliac artery, and terminates at the opening in the adductor magnus by becoming directly continuous with the popliteal artery.

Line of the Artery.—Having first slightly flexed the hip-joint, abduct and rotate the thigh outwards, and then draw a line from a point midway between the anterior superior spine of the ilium and the symphysis pubis, above, to the prominent tubercle on the internal condyle of the femur below. This line will indicate the course of the vessel.

Relations of the Artery to the Femur.—The artery is at

first in front of the innermost part of the head of the femur; it then comes to lie close to the inner side of the shaft of the bone about its middle; and, lastly, having become the popliteal artery, it lies altogether behind the femur. This change in the relations of the artery to the femur is due to the curve which the bone makes around the artery; the artery itself pursues a perfectly straight course.

Relations of the Femoral Artery in Scarpa's Triangle.—

To Muscles.—There are no muscles in front of the artery whilst it is in the triangle, but behind, from above downwards, there are the psoas muscle, which separates the artery from the pelvis and the hip-joint; the pectineus and adductor brevis muscles, from which the artery is separated by the femoral vein and the profunda vessels; and, lastly, the adductor longus.

To Veins.—The femoral vein crosses the artery from below upwards, and from without inwards. At the apex of Scarpa's triangle the vein lies behind, and slightly to the outer side of the artery, whilst at the base of the triangle the vein is on the same plane as the artery, and to its inner side.

The profunda vein passes behind the artery, to terminate in the femoral vein.

At the apex of Scarpa's triangle the femoral and profunda vessels are separated from each other by the adductor longus muscle, and have therefore the following relations to each other, from before backwards:—The femoral artery, the femoral vein, the adductor longus muscle, the profunda femoris vein, and the profunda femoris artery.

To Nerves.—The anterior crural nerve lies to the outer side of the artery, being separated from it by the psoas muscle and the iliacus fascia.

The internal or long saphenous nerve accompanies the artery into Hunter's canal, lying in front of, but never actually crossing the vessel.

The internal cutaneous nerve crosses the upper part of the artery at the inner border of the sartorius muscle.

The nerve to the pectineus muscle passes behind that portion of the artery which lies in the femoral sheath.

The crural branch of the genito-crural nerve lies to the outer side of the artery in the femoral sheath.

To other Structures.—The upper two inches of the femoral artery lie in the outermost compartment of the femoral sheath.

Branches of the Femoral Artery in Scarpa's Triangle.—The femoral artery gives off the following branches whilst it is passing through Scarpa's triangle:—

The superficial external pudic artery.

The superficial epigastric artery.

The superficial circumflex iliac artery.

The deep external pudic artery.

Muscular branches.

The deep femoral, or the profunda femoris artery.

The superficial branches have already been described. (See page 103.)

The Deep External Pudic Artery.—This vessel passes inwards a short distance below Poupart's ligament, in front of the pectineus and adductor longus muscles. It perforates the deep fascia at the inner side of the thigh, and is distributed to the scrotum in the male, and the labium pudendi in the female.

Muscular branches of small size are distributed by the artery to the muscles in the floor of Scarpa's triangle.

The Deep Femoral, or the Profunda Femoris Artery.—This vessel usually arises from the outer and back part of the femoral artery, about one and a half inches below Poupart's ligament. It is the largest branch given off by the femoral artery, and first passes outwards in front of the iliacus muscle, and then inwards and backwards, behind the femoral artery, and between the adductors longus and magnus. The artery terminates at the junction of the middle and lower thirds of the thigh, as the fourth or terminal perforating artery, which pierces the adductor magnus.

Branches.—The branches of the profunda femoris are as follows:—

The external circumflex artery.

The internal circumflex artery.

The four perforating arteries.

Muscular branches.

These vessels are described on page 119.

The Femoral Vein.—The femoral vein commences at the opening in the adductor magnus muscle, as the direct continuation of the popliteal vein. It terminates behind Poupart's ligament by becoming directly continuous with the external iliac vein. As the vein passes upwards, it crosses the femoral artery from without inwards, and at its termination is on the same plane as the artery. The last two inches of the vein, that is, the portion immediately below Poupart's ligament, lie in the femoral sheath.

Tributaries.—The femoral vein receives tributaries corresponding to all the branches of the artery, and, in addition, the internal or long saphenous vein.

The Anterior Crural Nerve.—This, the largest branch of the lumbar plexus, is derived from the second, third, and fourth nerves of the plexus. The nerve emerges at the outer border of the psoas muscle in the abdomen, and makes its appearance in the thigh behind Poupart's ligament, lying in the groove between the psoas and iliacus muscles, about a quarter of an inch external to the femoral artery. The nerve becomes flattened out, and almost immediately divides into two parts—a superficial or cutaneous, and a deep or muscular part.

(a) *The superficial or cutaneous part* gives off the following branches:—

The middle cutaneous nerve.

The internal cutaneous nerve.

The nerves to the sartorius muscle.

The nerve to the pectineus muscle.

The Middle Cutaneous Nerve.—This nerve occasionally pierces the inner border of the sartorius. It usually divides into two branches, which become cutaneous by piercing the deep fascia some three or four inches below Poupart's ligament. (See page 101.)

The Internal Cutaneous Nerve.—(See page 102.)

The Nerves to the Sartorius Muscle.—These are usually two or three in number, which arise in common with the middle cutaneous nerve.

The Nerve to the Pectineus Muscle.—This nerve arises just below Poupart's ligament, and passes inwards behind the femoral sheath to supply the pectineus muscle.

(b) *The deep division, or the muscular part* of the anterior crural nerve is described on page 122.

VI. THE DEEP DISSECTION OF THE FRONT OF THE THIGH

The Femoral Artery in Hunter's Canal.—Hunter's canal corresponds to the middle third of the thigh, Scarpa's triangle to the upper third. The femoral artery occupies both these regions, and corresponds, therefore, to the upper two-thirds of the femur.

Hunter's canal is situated on the inner side of the thigh. It extends from the apex of Scarpa's triangle to the opening in the adductor magnus muscle.

On transverse section the canal is distinctly triangular, possessing a base or roof which looks forwards, an apex which points backwards, and two lateral walls. *The base or roof* is formed by a layer of fascia passing from the inner to the outer wall of the canal, in front of which is the sartorius muscle. *The outer wall* is formed by the vastus internus muscle, and *the inner wall* by the adductors longus and magnus muscles. *The contents of the canal* from before backwards are the internal or long saphenous nerve, the femoral artery, and the femoral vein.

The internal or long saphenous nerve passes downwards in front of the femoral artery, and leaves the canal by passing from under cover of the lower thickened margin of its fascial roof. It is accompanied by the superficial division of the anastomotica magna artery.

The femoral vessels leave the canal and enter the popliteal space, by inclining backwards through the opening in the adductor magnus muscle.

As the femoral artery is not infrequently ligatured in Hunter's canal it is important to note that the superficial relations of the artery in this part of its course are, in order, from the surface:—skin, superficial fascia, deep fascia,

sartorius muscle, the fibrous expansion forming the roof of Hunter's canal, and the long saphenous nerve.

In the lower part of the canal the vein lies to the outer side of the artery, but as the vein is traced upwards through the canal it passes behind the artery.

Branches of the Femoral Artery in Hunter's Canal—These are as follows:—

Muscular branches are given off irregularly to the vastus internus, adductor longus, and sartorius muscles.

The Anastomotica Magna Artery arises from the femoral close to the opening in the adductor magnus muscle, and almost immediately divides into a superficial and a deep branch.

(a) *The superficial branch* accompanies the internal or long saphenous nerve to the inner side of the knee, and, after supplying the muscles and the skin, it anastomoses with the inferior internal articular artery from the popliteal.

(b) *The deep branch* runs downwards in the substance of the vastus internus muscle, immediately in front of the tendon of the adductor magnus muscle, to the inner condyle of the femur; after supplying the muscles in this region it anastomoses with the superior internal articular artery, as well as with the superior external articular artery.

The Quadriceps Extensor Muscle.—This large and powerful muscle consists, at its origin, of four distinct muscles, which unite to form a common tendon of insertion, the *ligamentum patellæ*.

The four parts of the quadriceps extensor are: the rectus femoris, the vastus externus, the vastus internus, and the crureus muscles.

(a) *The Rectus Femoris Muscle.*—This muscle extends from the pelvis to the tibia, and arises by two tendinous heads, a short head and a long or reflected head.

The short head arises from the anterior inferior spine of the ilium and from part of the notch above.

The long or reflected head arises from a roughened impression immediately above the acetabulum. The two heads unite just below the acetabulum at an angle of about 60° .

(b) *The Vastus Externus Muscle.*—This muscle forms the

prominent muscular mass on the outer side of the thigh. It has a long and narrow origin from the femur, as follows:—

From the upper half of the anterior intertrochanteric line, from the front of the great trochanter, from the lower border of the external surface of the great trochanter, from the outer side of the gluteal ridge, from the upper half of the outer lip of the linea aspera, and slightly from the external intermuscular septum.

The line of demarcation between the vastus externus and crureus muscles is formed by the descending branch of the external circumflex artery.

(c) *The Vastus Internus Muscle*.—This muscle is much more nearly blended with the crureus than is the vastus externus muscle. It has the following origin:—

From the spiral line of the femur, from the whole length of the inner lip of the linea aspera, and, in its lower part, from the tendons of the adductors longus and magnus muscles.

(d) *The Crureus Muscle*.—This muscle rests upon the femur, arising from the upper two-thirds of the anterior and external surfaces of that bone, and also from the external intermuscular septum in its lower half.

The internal surface of the femur is entirely free from muscular attachments. The name *subcrureus* is sometimes given to the deeper fibres of the crureus.

The Insertion of the Quadriceps Extensor Muscle.—The quadriceps extensor muscle is inserted into the tubercle of the tibia, and the patella is to be regarded as a sesamoid bone developed in its tendon. The tendon of insertion of the quadriceps extensor may therefore be divided into a *suprapatellar* portion and an *infrapatellar* portion, the latter constituting the true insertion of the muscle.

(a) *The suprapatellar tendon* results from the union of the four muscles which form the quadriceps extensor muscle. It is about three inches long, and passes down to the upper border of the patella. Between this tendon and the femur there is a bursa, which frequently communicates with the synovial membrane of the knee-joint.

(b) *The infrapatellar tendon*, or the ligamentum patellæ,

is the true tendon of insertion of the quadriceps extensor muscle. It is two inches long, and extends from the lower border of the patella to the lowest part of the anterior tubercle of the tibia, into which it is inserted. It is separated from the upper part of the tubercle by a bursa.

Nerve Supply of the Quadriceps Extensor Muscle.—All the four parts of the quadriceps extensor are supplied by branches from the muscular or deep division of the anterior crural nerve.

Action of the Quadriceps Extensor Muscle.—This muscle is a powerful extensor of the knee-joint, but is not required to maintain the body in the erect attitude whilst standing. The rectus femoris also flexes the hip-joint.

The Intermuscular Septa.—The intermuscular septa are processes of deep fascia which are sent inwards to the femur. They are three in number, but only two of these are specially named and described; these two are the internal and external intermuscular septa.

(a) *The external intermuscular septum* passes inwards from the deep fascia to the femur. It extends from the insertion of the gluteus maximus muscle to the external condyle of the femur. It lies between the crureus and vastus externus muscles which are in front of it, and the short head of the biceps which is behind it. All of these muscles arise, in part, from it. Just above the external condyle of the femur it is pierced by the superior external articular vessels.

(b) *The internal intermuscular septum* is much weaker than the external, and only extends downwards as far as the linea aspera, being replaced beyond that by the tendon of the adductor magnus.

The three intermuscular septa subdivide the thigh into three regions:—

An anterior or extensor region, containing the extensor muscles and the anterior crural nerve.

A posterior or flexor region, containing the flexor or hamstring muscles and the great sciatic nerve.

An internal or adductor region, containing the adductor muscles and the obturator nerve. The association of these

nerves with the various groups of muscles should be noted particularly.

The Ilio-Tibial Band.—The ilio-tibial band is that specially thickened portion of the fascia lata which is situated on the outer side of the thigh, and which extends from the external tuberosity of the tibia and the head of the fibula below, to the ilium above.

This upper or iliac attachment is peculiar. On tracing the ilio-tibial band upwards it will be found to split, at the junction of the upper and middle thirds of the thigh and on the outer surface of the vastus externus, into two lamellæ—superficial and deep.

The superficial lamella passes upwards on the outer surface of the tensor fasciæ femoris muscle to the crest of the ilium, where it becomes continuous posteriorly with the gluteal aponeurosis.

The deep lamina passes upwards on the inner surface of the tensor fasciæ femoris to the capsular ligament of the hip-joint, with which it blends.

The Tensor Fasciæ Femoris Muscle.—This muscle is situated at the outer part of the thigh, occupying its upper third.

Origin.—From the anterior superior iliac spine and part of the notch below, just external to the origin of the sartorius muscle.

Insertion.—The muscle passes downwards, outwards, and backwards, to be inserted into the splitting of that portion of the fascia lata of the thigh which is termed the ilio-tibial band, and which extends downwards to the outer tuberosity of the tibia.

Nerve Supply.—The lower branch of the superior gluteal nerve.

Action.—From the peculiar insertion of this muscle into the fascia lata it will assist the gluteus maximus muscle in supporting the knee in the extended position. The muscle also assists in abducting and rotating the thigh inwards.

The Branches of the Profunda Femoris Artery.—The branches of the profunda femoris artery are found both on

the front of the thigh and also in the adductor region. It is convenient to consider them all with this region. The branches are as follows:—

The external circumflex artery.

The internal circumflex artery.

The four perforating arteries.

Muscular branches.

The External Circumflex Artery.—This vessel, the largest of those given off by the profunda, arises from the outer side of that artery, near its commencement. It passes outwards behind the sartorius and rectus femoris muscles, and between the divisions of the anterior crural nerve. It terminates by dividing into three branches, ascending, transverse, and descending.

(a) The *ascending terminal* branch passes upwards on the inner side of the tensor fasciæ femoris muscle, and anastomoses with the gluteal artery. It supplies the gluteal muscles and the hip-joint.

(b) The *transverse terminal* branch passes outwards in front of the crureus muscle, enters the substance of the vastus externus muscle, and anastomoses with the perforating arteries, and with the transverse terminal branch of the external circumflex artery.

(c) The *descending terminal* branch, the largest of the three, runs downwards in the interval between the vastus externus and crureus muscles to the knee-joint, where it anastomoses with the superior external articular artery. It supplies the quadriceps extensor muscle.

The Internal Circumflex Artery.—This vessel arises from the inner and posterior part of the profunda opposite the external circumflex artery, and passes directly backwards to the buttock, between three pairs of muscles. It disappears from view on the front of the thigh, by passing backwards between the psoas and pectineus muscles; it then passes between the obturator externus and adductor brevis muscles, and appears in the buttock in the fourth intermuscular space, between the quadratus femoris and adductor magnus muscles. The vessel supplies the muscles between which it passes, gives off an articular branch to the hip, and then terminates

opposite the small trochanter of the femur by dividing into its two terminal branches, ascending and transverse.

(a) The *ascending terminal* branch accompanies the tendon of the obturator externus muscle, and supplies the external rotator muscles of the thigh. It is seen in the third intermuscular space of the buttock.

(b) The *transverse terminal* branch is seen in the fourth intermuscular space of the buttock. It supplies the hamstring muscles, and anastomoses with the transverse terminal branch of the external circumflex artery. In this way an arterial ring is formed around the upper end of the femur. This ring is joined by branches from the sciatic artery above, and by the first perforating artery below. To this the term *crucial anastomosis* is sometimes applied.

The Four Perforating Arteries.—The perforating arteries are very variable, but are usually four in number, including the terminal branch of the profunda femoris itself.

The perforating arteries pass backwards close to the femur, piercing the adductor magnus muscle, and supplying the hamstring muscles, the great sciatic nerve, and giving off cutaneous branches to the skin which run along the external intermuscular septum. They eventually terminate in the substance of the vastus externus and crureus muscles.

(a) The *first perforating* artery rises opposite the lower border of the pectineus muscle, and passes backwards through the adductors brevis and magnus muscles. One of its branches anastomoses with the gluteal, sciatic, and internal circumflex arteries.

(b) The *second perforating* artery usually arises just above the lower border of the adductor brevis muscle, but is also very frequently conjoined at its origin with the first perforating artery. It pierces the adductors brevis and magnus muscles.

(c) The *third perforating* artery arises just below the adductor brevis, and therefore pierces the adductor magnus muscle only. The principal nutrient artery for the femur is derived from either the second or third perforating.

(d) The *fourth perforating* artery is the terminal branch

of the profunda femoris itself. It pierces the adductor magnus muscle near the opening for the femoral artery, and supplies the biceps flexor cruris muscle, and very frequently gives off a second nutrient artery to the femur.

Muscular Branches.—Muscular branches of irregular origin and size are given off by the profunda to the adductor muscles.

The Deep Division or the Muscular Part of the Anterior Crural Nerve.—The deep division of the anterior crural nerve is principally intended for the supply of the quadriceps extensor muscle. It also gives off cutaneous and articular filaments, as follows:—

Muscular branches to the quadriceps extensor muscle.

One branch to the rectus femoris muscle.

Two branches to the vastus externus muscle.

Three branches to the crureus muscle.

One branch to the vastus internus muscle.

A cutaneous branch.

The internal or long saphenous nerve.

Articular filaments.

To the hip-joint.

To the knee-joint.

The internal or long saphenous nerve is the largest branch given off by the anterior crural nerve. It accompanies the femoral artery into Hunter's canal, lying in front of the vessel, but never actually crossing it. It leaves the canal by passing from under cover of the lower thickened margin of its fascial roof, and becomes cutaneous by piercing the deep fascia just below, and to the inner side of the knee.

This nerve gives off two branches in the thigh—one to the subsartorial plexus, and the other to the patellar plexus.

The articular filament to the hip arises from the nerve to the rectus femoris muscle.

The articular filaments to the knee arise from the muscular branches to the vastus externus, crureus, and vastus internus muscles. The articular filament to the knee which arises from the nerve to the vastus internus, accompanies the deep division of the anastomotica magna artery.

VII. THE INTERNAL OR ADDUCTOR REGION

The muscles found in this region are as follows:—

1. The obturator externus muscle.
2. The adductor group of muscles—
 - (a) The pectineus muscle.
 - (b) The adductor gracilis muscle.
 - (c) The adductor longus muscle.
 - (d) The adductor brevis muscle.
 - (e) The adductor magnus muscle.

All these muscles are supplied by the obturator nerve. The pectineus and the adductor magnus muscles have a double nerve supply; the pectineus being supplied by both the obturator and the anterior crural nerves, and the adductor magnus by the obturator and great sciatic nerves.

The Obturator Externus Muscle.—This muscle is a somewhat triangular muscle situated on the outer surface of the obturator membrane, and having its base at the pelvis, and its apex at the femur.

Origin.—From the inner half of the external surface of the obturator membrane, from the femoral surface of the body of the pubis, and from the rami of the pubis and ischium.

Insertion.—The muscular fibres end in a rounded tendon which lies in a groove on the inferior and posterior surfaces of the neck of the femur, and which, winding backwards and upwards, is inserted into the digital fossa of the great trochanter.

Nerve Supply.—The posterior division of the obturator nerve, which pierces the muscle.

Action.—The principal action of the obturator externus muscle is that of external rotation of the femur; it also assists in flexing and adducting the femur.

Relations.—This muscle is in contact with the capsular ligament of the hip-joint. Its tendon of insertion is found, in part, in the third intermuscular space of the buttock, where it is partially concealed by the quadratus femoris muscle.

The obturator nerve divides just above the upper border

of the muscle. Its superficial division passes down in front of the muscle, whilst its deep division pierces and supplies it.

The obturator vessels lie between the muscle and the obturator membrane.

The Obturator Artery.—This vessel arises in the pelvis and enters the thigh through the obturator foramen, where it immediately divides into its two terminal branches, external and internal, both of these ramifying on the obturator membrane between that structure and the obturator externus muscle. The terminal branches of this vessel supply the adductor muscles near their origins, the obturator muscles, and the hip-joint.

The Adductor Muscles.—The adductor muscles are a powerful group of muscles situated on the inner part of the thigh. They are five in number, as follows:—

The pectineus muscle.

The adductor gracilis muscle.

The adductor longus muscle.

The adductor brevis muscle.

The adductor magnus muscle.

These five muscles may be regarded as being arranged in three strata.

The anterior stratum comprises, from above downwards, the pectineus, adductor longus, and gracilis muscles.

The intermediate stratum, the adductor brevis muscle.

The posterior stratum, the adductor magnus muscle.

Between these various strata the two divisions of the obturator nerve pass downwards to supply the various adductor muscles. The anterior division passes downwards between the first and second strata, and the posterior division of the nerve passes downwards between the second and third strata.

The Pectineus Muscle.—Already described. (*See* page 109.)

The Adductor Gracilis Muscle.—This is a long ribbon-like muscle, which extends from the pelvis to the tibia, along the inner side of the thigh and knee.

Origin.—From the lower half of the symphysis pubis,

and from the whole length of the inner border of the ramus of the pubis.

Insertion.—In the lower third of the thigh the muscle ends in a rounded tendon, which curves forwards below the knee, to be inserted into the upper part of the internal surface of the shaft of the tibia, behind the insertion of the sartorius, and on the same plane as, but at a higher level than, the insertion of the semitendinosus.

Nerve Supply.—The superficial division of the obturator nerve.

Action.—The gracilis is an adductor of the thigh, but it also assists in flexing the knee and rotating it inwards.

Relations.—The adductor gracilis is subcutaneous almost throughout its whole extent.

Its tendon of insertion is only separated from the internal lateral ligament of the knee-joint by a bursa.

Between this muscle and the adductor longus, the cutaneous filament from the superficial division of the obturator nerve to the subsartorial plexus makes its appearance.

The Adductor Longus Muscle.—This is a somewhat triangular strap-like muscle which passes from the pubic region to the middle third of the shaft of the femur; the apex of the triangle corresponds to the origin, and the base of the triangle to the insertion.

Origin.—By a rounded tendon, from the femoral surface of the body of the pubis, in the angle between the crest and the symphysis pubis.

Insertion.—Into the whole length of the inner lip of the linea aspera.

Nerve Supply.—The superficial division of the obturator nerve.

Action.—A powerful adductor of the thigh, and a secondary flexor of the hip-joint.

Relations.—This muscle takes part in the formation of both the inner boundary and floor of Scarpa's triangle.

Near its insertion it separates the femoral vessels from the profunda vessels, and also forms one of the internal boundaries of Hunter's canal.

The posterior surface of the adductor longus muscle rests upon the adductors brevis and magnus muscles, and the superficial division of the obturator nerve.

The Adductor Brevis Muscle.—*Origin.*—From the femoral surface of the body and ramus of the pubis, immediately below the origin of the adductor longus, and between the origin of the gracilis which is internal to it, and that of the adductor magnus muscle which is external to it.

Insertion.—Into the whole length of the line leading from the inner lip of the linea aspera to the small trochanter of the femur.

Nerve Supply.—Either the superficial or the deep division of the obturator nerve, or both of these divisions.

Action.—A powerful adductor of the thigh, and also a secondary flexor of the hip-joint.

Relations.—The adductor brevis is usually concealed by the pectineus and adductor longus muscles, but in subjects of no very great muscularity part of the anterior surface of the muscle may be seen between these two muscles, in which case the adductor brevis will form part of the floor of Scarpa's triangle.

The adductor brevis separates the two divisions of the obturator nerve, the superficial division passing down in front of the muscle, and the deep division behind it.

The posterior or deep surface of the adductor brevis rests upon the obturator externus and adductor magnus muscles, and the internal circumflex artery passes backwards to the buttock above the upper border of the brevis, between it and the obturator externus muscle.

The Adductor Magnus Muscle.—This large and powerful muscle is somewhat triangular in outline, the base of the triangle corresponding to the insertion of the muscle, which is into the whole length of the femur.

Origin.—From the lower part of the femoral surface of the pubis, just external to the origin of the adductor brevis, from the rami of the pubis and ischium, and from the lower facet of the ischial tuberosity.

Insertion.—Into the whole length of the shaft of the femur, as follows :—

Into the posterior part of the femur just internal to the gluteal ridge; into the intermediate rough surface between the two lips of the linea aspera; into the lower part of the internal supracondylar ridge of the femur; and, lastly, into the adductor tubercle.

This insertion into the femur is interrupted at various intervals by a series of tendinous arches which transmit the perforating arteries from the profunda femoris and the femoral vessels themselves. The largest of these arches is, of course, that for the femoral vessels; it is situated just below the bifurcation of the two lips of the linea aspera into the two supracondylar ridges, and corresponds to the termination of Hunter's canal.

Nerve Supply.—The deep division of the obturator nerve and the great sciatic nerve.

Action.—A very powerful adductor of the thigh. The most posterior fibres, which arise from the ischial tuberosity and which are inserted into the adductor tubercle, may also assist in extending the hip-joint.

Relations.—The adductor magnus is the most posterior and the largest of the adductor muscles.

Its *anterior surface* is in contact with the adductors brevis and longus, the vastus internus, the deep division of the obturator nerve, and with the profunda femoris vessels.

Its *posterior surface* is in contact with the gluteus maximus and hamstring muscles, and the great sciatic nerve.

The *upper border* of the muscle is in contact with the obturator externus and quadratus femoris muscles, and the internal circumflex artery passes backwards to the buttock between this last muscle and the upper border of the adductor magnus.

The *internal border* of the adductor magnus is in contact with the gracilis and sartorius muscles.

The Obturator Nerve.—This nerve arises from the second, third, and fourth nerves of the lumbar plexus. It enters the thigh through the obturator foramen, in which it divides into an anterior or superficial division, and a posterior or deep division.

The Anterior or Superficial Division.—This part of the

nerve passes downwards in front of the obturator externus and adductor brevis muscles lying between the pectineus, adductor longus, and gracilis muscles in front, and the adductor brevis muscle behind; it gives off muscular, articular, and cutaneous filaments, as follows:—

Muscular branches—

To the pectineus muscle.

To the adductor longus muscle.

To the adductor gracilis muscle.

To the adductor brevis muscle.

An articular filament to the hip-joint.

A cutaneous filament to the subsartorial plexus.

The Posterior or Deep Division.—This part of the nerve descends through the fibres of the obturator externus muscle, and then behind the adductor brevis, lying between that muscle, and the adductor magnus in which it terminates. This part of the nerve gives off muscular and articular filaments, as follows:—

Muscular branches—

To the obturator externus muscle.

To the adductor brevis muscle.

To the adductor magnus muscle.

Articular filament to the knee-joint.

The articular filament to the knee-joint, sometimes known as *the geniculate branch of the obturator*, is often absent. When present, it pierces the adductor magnus muscle near the opening for the femoral vessels, and then, accompanying the popliteal vessels, pierces the posterior ligament of the knee-joint and supplies that joint.

The Accessory Obturator Nerve.—This nerve, when present, arises in the abdomen from the third and fourth lumbar nerves, between the roots of the obturator and anterior crural nerves. It enters the thigh in front of the ascending ramus of the pubis, and, passing behind the pectineus muscle, ends by dividing into three branches.

One of these branches joins the anterior or superficial division of the obturator nerve; a second enters the posterior surface of the pectineus muscle; and the third supplies the hip-joint.

The nerve is stated to be present in one out of every four subjects.

THE LEG

Definition.—By the “leg” is meant that part of the lower limb which extends from the knee to the ankle-joint. Under no circumstances whatsoever should the term be employed in any other sense.

The Deep Fascia of the Leg.—The disposition of the deep fascia of the leg is best seen in transverse section. Such a section shows the deep fascia to be attached to the anterior border of the tibia, from whence it sweeps round the outer side of the leg to be attached to the posterior border of the tibia; there is thus no deep fascia over the internal surface of the tibia, nor is the deep fascia attached *directly* to the fibula.

When traced upwards, the deep fascia of the leg is seen to be attached to the internal and external tuberosities of the tibia, and to the head of the fibula; posteriorly, it becomes continuous with the strong popliteal fascia; below, it is attached to the malleoli.

From the deep fascia two processes are sent inwards to the fibula—the anterior and the posterior peroneal septa. The *anterior peroneal septum* passes inwards to the anterior border of the fibula, and the *posterior peroneal septum* similarly passes inwards to the posterior border of the fibula.

In the front of the leg there is a septum which passes backwards in the upper third of the leg, between the tibialis anticus and extensor longus digitorum muscles.

On the back of the leg there is another process of deep fascia which lies between the superficial and deep muscles, and which binds the deep muscles down to the tibia and fibula.

The deep fascia of the leg is specially thickened in the neighbourhood of the ankle-joint, forming the annular ligaments. These are described with their respective regions.

Subdivision of the Leg into Four Regions.—The arrangement of the deep fascia, together with its peroneal

septa, permits of the division of the leg into four regions, as follows:—

An internal or tibial region.

An extensor or anterior tibio-fibular region, with which is associated the dorsum of the foot.

A peroneal or external region.

A flexor or posterior tibio-fibular region, which is further subdivided into a superficial and a deep compartment.

The last three regions, that is, all those regions which contain muscles, have a particular nerve associated with them, as follows:—

The extensor region.—The anterior tibial nerve.

The peroneal region.—The musculo-cutaneous nerve.

The flexor region.—

(a) Superficial compartment.—The internal popliteal nerve.

(b) Deep compartment.—The posterior tibial nerve.

VIII. THE INTERNAL OR TIBIAL REGION

This region is a purely subcutaneous region, and corresponds to the internal or subcutaneous surface of the tibia.

Into the upper part of this surface of the tibia are the insertions of the sartorius, gracilis, and semitendinosus muscles, already described. Crossing obliquely over the lower third of the region are the internal or long saphenous nerve and vein.

The Internal or Long Saphenous Nerve.—This nerve becomes cutaneous, just below and to the inner side of the knee. It then passes downwards along the inner side of the leg, accompanied by the internal or long saphenous vein, and, passing in front of the internal malleolus, terminates on the inner side of the foot, opposite the tubercle of the scaphoid bone. It gives off numerous branches to the skin of the leg, the largest of which turn forwards in front of the anterior border of the tibia.

The Internal or Long Saphenous Vein.—This vein commences on the inner side of the dorsal venous plexus of the foot; it passes upwards in front of the internal malleolus,

accompanied by the nerve of the same name, and is then continued upwards behind the inner border of the tibia, to the inner side of the knee-joint. Its further course, to its termination in the femoral vein, has already been described. (See page 103.)

IX. THE EXTENSOR OR ANTERIOR TIBIO-FIBULAR REGION, AND THE DORSUM OF THE FOOT

Boundaries.—The extensor region is bounded in front by the deep fascia; externally, by the anterior peroneal septum; internally, by the external surface of the tibia; posteriorly, by the anterior or extensor surface of the fibula, and the interosseous membrane.

Contents.—The contents of this region are as follows:—

The extensor group of muscles—

- (a) The *tibialis anticus*.
- (b) The *extensor longus digitorum*.
- (c) The *extensor proprius hallucis*.
- (d) The *peroneus tertius*.
- (e) The *extensor brevis digitorum*.

The anterior tibial nerve, which supplies all the above muscles.

The anterior tibial vessels.

The *tibialis anticus* muscle is in relation to the tibia, resting against the external surface of the shaft of that bone.

The *extensor longus digitorum* lies upon the fibula.

The *extensor proprius hallucis* lies between the *tibialis anticus* and the *extensor longus digitorum*.

The *peroneus tertius* is a misnamed muscle. It is not a peroneal muscle but an extensor muscle, and it appears to form part of the *extensor longus digitorum*. It is found in front of the lower end of the fibula.

The *extensor brevis digitorum* lies on the dorsal surface of the foot.

The Superficial Veins.—On the dorsal surface of the foot there is a subcutaneous plexus of veins, which receives the dorsal veins from the toes and some few tributaries from

the sole. This dorsal venous plexus forms a more or less regular arch, from the extremities of which proceed the internal or long, and the external or short saphenous veins. The former passes upwards in front of the internal malleolus, the latter behind the external malleolus. Each vein is accompanied by the corresponding nerve.

Cutaneous Nerves.—The cutaneous nerves for the front of the leg and the dorsal surfaces of the foot and toes are derived from the following sources:—

The musculo-cutaneous nerve.

The anterior tibial nerve.

The external or short saphenous nerve.

The internal or long saphenous nerve.

Filaments from the external popliteal nerve.

The Musculo-Cutaneous Nerve.—This nerve, one of the terminal branches of the external popliteal nerve, becomes cutaneous by piercing the deep fascia in the lower third of the leg, and almost immediately divides into two branches, internal and external.

(a) The *internal branch* of the musculo-cutaneous nerve supplies the skin over the inner side of the great toe, and the adjacent sides of the second and third toes. It also supplies the skin over the internal malleolus and inner side of the foot, and communicates with the internal saphenous and anterior tibial nerves.

(b) The *external branch* of the musculo-cutaneous nerve supplies the skin over the adjacent sides of the third and fourth, and fourth and fifth toes. It also supplies the skin over the external malleolus and outer side of the foot, and communicates with the short or external saphenous nerve.

The Anterior Tibial Nerve.—This nerve, the other terminal branch of the external popliteal nerve, subsequently divides into an internal and an external branch, only the former of which becomes cutaneous.

The *internal branch* of the anterior tibial nerve becomes cutaneous in the first interosseous space, and supplies the skin on the adjacent sides of the first and second toes. It usually communicates with the internal branch of the musculo-cutaneous nerve.

The External or Short Saphenous Nerve.—This nerve is formed on the back of the leg by the junction of the rami communicantes tibialis et fibularis. It passes behind the external malleolus, with the vein of the same name, and supplies the skin over the outer side of the foot and little toe.

The Internal or Long Saphenous Nerve.—This nerve descends in front of the internal malleolus, accompanied by the vein of the same name. It supplies the skin over the inner part of the leg and the inner side of the foot, as far as the tubercle of the scaphoid bone.

The External Popliteal Nerve.—Branches from this nerve are given off to the upper part of the front and outer sides of the leg.

The Anterior Annular Ligament.—The anterior annular ligament is a specially thickened and specially named portion of the deep fascia. It consists of two portions—upper and lower.

The Upper Portion.—The upper portion of the anterior annular ligament stretches transversely between the anterior borders of the tibia and fibula, just above the malleoli.

Passing behind this part of the ligament are the tendons of the tibialis anticus, extensor longus digitorum, extensor proprius hallucis, and peroneus tertius muscles, the first of which alone has a synovial membrane. The anterior tibial artery and nerve also pass behind this part of the ligament, between the tendons of the extensor proprius hallucis and the extensor longus digitorum.

The Lower Portion.—The lower portion of the anterior annular ligament has the form of the letter Y placed upon its side, being single in its outer portion and bifurcated in its inner portion.

The stem of the Y is attached to the upper surface of the os calcis in front of the interosseous ligament. Of the two internal limbs of the Y, the upper and more constant of the two is attached to the internal malleolus, whilst the lower one is attached to the plantar fascia on the inner side of the sole of the foot.

In this part of the ligament there are three synovial

membranes: the inner one, for the tibialis anticus, which is continuous with the synovial membrane in the upper part of the ligament; a middle one, for the extensor proprius hallucis; and an external one, common to the extensor longus digitorum and peroneus tertius muscles.

The Muscles of the Extensor Region and the Dorsum of the Foot.—The muscles found in the anterior tibio-fibular region are the extensor muscles; and on the dorsum of the foot, the extensor brevis digitorum, as follows:—

The tibialis anticus muscle.

The extensor longus digitorum muscle.

The extensor proprius hallucis muscle.

The peroneus tertius muscle.

The extensor brevis digitorum muscle.

These muscles are all supplied by the anterior tibial nerve.

The Tibialis Anticus Muscle.—This muscle extends from the tibia to the inner side of the foot.

Origin.—From the outer tuberosity of the tibia, and the upper half of the external surface of the shaft of the tibia.

From the deep fascia of the leg.

From the intermuscular septum between this muscle and the extensor longus digitorum muscle.

From the interosseous membrane.

Insertion.—The tendon of the tibialis anticus commences about the middle of the leg, and passes downwards behind both divisions of the anterior annular ligament, lying in the synovial membrane found behind both portions of this ligament, to be inserted into the inner side of the base of the first metatarsal and internal cuneiform bones.

Nerve Supply.—The anterior tibial nerve from the external popliteal.

Action.—This muscle is a powerful inverter of the foot at the transverse tarsal articulation, and, secondarily, a flexor of the ankle-joint. Although it is always classified with the extensor group of muscles, it has no extensor action on the toes whatsoever.

The Extensor Longus Digitorum Muscle.—This muscle extends from the front of the leg to the four outer toes.

Origin.—From the outer tuberosity of the tibia, the anterior or extensor surface of the shaft of the fibula in its upper two-thirds, and the interosseous membrane.

From the deep fascia of the leg.

From the anterior peroneal septum.

From the intermuscular septum between this muscle and the tibialis anticus.

Both the tibialis anticus and the extensor longus digitorum practically arise from four sides of a square.

Insertion.—In the lower part of the leg the tendon divides into four slips, which descend through the lower part of the anterior annular ligament in the same synovial sheath as the peroneus tertius, and thence over the dorsum of the foot to the four outer toes.

Over the proximal or metatarsal phalanx, each one of these tendons, with the exception of that to the little toe, is joined on the outer side by a tendon from the extensor brevis digitorum, and by tendinous processes from the lumbrical and interosseous muscles to form a dorsal extensor expansion.

The dorsal extensor expansion divides into three parts, the central portion of which is inserted into the base of the middle phalanx, whilst the two lateral parts unite together again, and are inserted into the base of the terminal phalanx.

Nerve Supply.—The anterior tibial nerve.

Action.—This muscle *primarily* extends the interphalangeal joints of the toes, and *secondarily* flexes the ankle-joint.

The Dorsal Extensor Expansion of the Toes.—The dorsal extensor expansion is formed on the various digits as follows:—

On *the first or great toe* there is no dorsal extensor expansion; there are only the tendons of the extensor proprius hallucis, and the innermost slip of the extensor brevis digitorum.

On *the second toe* the dorsal extensor expansion is formed by the extensor longus digitorum, the second slip of the extensor brevis digitorum, the first lumbrical muscle, and the first and second dorsal interossei muscles.

On *the third toe*, by the extensor longus digitorum, the

third slip of the extensor brevis digitorum, the second lumbrical muscle, the third dorsal interosseous muscle, and the first plantar interosseous muscle.

On *the fourth toe*, by the extensor longus digitorum, the fourth slip of the extensor brevis digitorum, the third lumbrical, the fourth dorsal interosseous, and the second plantar interosseous muscles.

On *the fifth toe*, by the outermost slip of the extensor longus digitorum, the fourth lumbrical, and the third plantar interosseous muscle.

The Extensor Proprius Hallucis Muscle.—*Origin.*—From the middle two-fourths of the anterior or extensor surface of the shaft of the fibula, and from the adjacent part of the interosseous membrane, the muscle lying between the origins of the extensor longus digitorum and tibialis anticus muscles.

Insertion.—Into the base of the terminal phalanx of the great toe.

Nerve Supply.—The anterior tibial nerve.

Action.—A *primary* extensor of the joints of the great toe, and a *secondary* flexor of the ankle-joint.

Relations.—The tendon of this muscle crosses the anterior tibial vessels in the lower third of the leg from without inwards.

The Peroneus Tertius Muscle.—This muscle is not a true peroneal muscle. It forms part of the long extensor of the toes.

Origin.—From the lower third of the anterior or extensor surface of the shaft of the fibula.

From the adjacent part of the interosseous membrane, and from the anterior peroneal septum.

Insertion.—Into the upper surface of the base of the fifth metatarsal bone.

Nerve Supply.—The anterior tibial nerve.

Action.—This muscle is, developmentally, part of the extensor brevis digitorum muscle as that muscle at one time arose from the front of the leg. The greater part of that muscle has passed down to the dorsal surface of the foot, so that now the peroneus tertius, having remained behind, *appears* as part of the extensor longus digitorum

muscle. Its action is therefore a very subsidiary one, and merely serves to assist in flexing the ankle-joint.

The Extensor Brevis Digitorum Muscle.—This muscle lies on the dorsal surface of the foot, and passes from thence to the four inner toes.

Origin.—From the anterior part of the upper and outer surfaces of the os calcis, and from the lower division of the anterior annular ligament.

Insertion.—By means of four tendons into the four inner digits; the innermost tendon is inserted separately into the base of the first phalanx of the great toe, the others by means of the dorsal extensor expansion.

Nerve Supply.—The external terminal branch of the anterior tibial nerve.

Action.—A primary extensor of the joints of the four inner toes.

Relations.—The innermost tendon crosses the dorsalis pedis artery and the internal terminal branch of the anterior tibial nerve obliquely from without inwards.

The Anterior Tibial Nerve.—This nerve is one of the two terminal branches of the external popliteal nerve. It commences opposite the neck of the fibula, in the substance of the peroneus longus muscle, by the bifurcation of the external popliteal into anterior tibial and musculo-cutaneous nerves.

From this origin the nerve passes obliquely downwards and inwards under cover of the extensor longus digitorum to the interosseous membrane, where it comes into contact with the anterior tibial vessels in the upper third of the leg; from this point onwards the nerve is placed in front of the anterior tibial artery until just above the ankle-joint, when the nerve again passes to the outer side of the artery, and just in front of that joint the nerve terminates by dividing into an internal and an external branch.

Branches.—The branches of the anterior tibial nerve may be classified as follows:—

Muscular branches to the extensor muscles—

To the tibialis anticus.

To the extensor longus digitorum.

To the extensor proprius hallucis.

To the peroneus tertius.

An articular filament to the ankle-joint.

An external terminal branch.

An internal terminal branch.

The External Terminal Branch commences opposite the ankle-joint. It passes outwards between the extensor brevis digitorum muscle and the tarsus, and terminates in a slight gangliform enlargement which supplies the extensor brevis digitorum muscle and the tarsal articulations.

The Internal Terminal Branch lies on the outer side of the dorsalis pedis artery, and accompanies that vessel as far as the first interosseous space. Here it becomes cutaneous and supplies the adjacent sides of the first and second toes, as well as giving off articular filaments to the joints of the hallux.

The Anterior Tibial Artery.—This artery arises on the back of the leg opposite the lower border of the popliteus muscle by the bifurcation of the popliteal artery into posterior and anterior tibial arteries. The vessel reaches the front of the leg by passing forwards through the upper part of the tibialis posticus muscle and the interosseous membrane, and appears on the front of the leg, close to the inner side of the neck of the fibula. From this point the vessel descends to the front of the ankle-joint, where it terminates by becoming directly continuous with the dorsalis pedis artery.

Line of the Artery.—The course of the anterior tibial artery may be indicated on the living subject by a line drawn from a point midway between the head of the fibula and the external tuberosity of the tibia, to a point on the front of the ankle-joint midway between the two malleoli.

Relations.—Posteriorly, the anterior tibial artery rests upon the interosseous membrane in the upper two-thirds of its course, and in its lower third upon the tibia and the ankle-joint.

In the upper two-thirds of its course the anterior tibial artery lies between the extensors longus digitorum and proprius hallucis muscles to its outer side, and the tibialis anticus to its inner side.

In its lower third the artery is crossed obliquely from without inwards by the tendon of the extensor proprius hallucis, and the termination of the vessel is placed behind the upper portion of the anterior annular ligament.

The anterior tibial artery is accompanied by two venæ comites; the anterior tibial nerve approaches the artery from the outer side in the upper part of the leg, lies in front of the artery in the greater part of its course, and, lastly, again lies to the outer side in the lower part of the leg.

Branches.—The branches of the anterior tibial artery are as follows:—

On the back of the leg—

The superior fibular artery.

The posterior tibial recurrent artery.

On the front of the leg—

The anterior tibial recurrent artery.

Muscular branches.

The external malleolar artery.

The internal malleolar artery.

The Superior Fibular Artery arises from the anterior tibial on the back of the leg, but it is convenient to discuss both this branch and the next, which has a similar origin, with the other branches. The superior fibular artery is a small inconstant and variable vessel, which, when present, runs outwards across the neck of the fibula, between that bone and the soleus muscle, to supply the soleus, the peroneus longus, and the skin.

The Posterior Tibial Recurrent Artery is a small vessel which passes upwards on the back of the leg between the popliteus muscle and the tibia, to the knee-joint and the superior tibio-fibular articulation.

The Anterior Tibial Recurrent Artery arises from the anterior tibial as soon as that vessel has appeared on the front of the leg. It runs upwards through the substance of the tibialis anticus muscle, and takes part in the anastomosis around the knee-joint.

The Muscular Branches are given off to the various extensor muscles.

The External Malleolar Artery arises near the ankle-

joint, and passes outwards behind the tendons of the extensor longus digitorum and peroneus tertius muscles to the external malleolus, anastomosing there with the anterior peroneal and tarsal arteries, and supplying the tarsal articulations.

The Internal Malleolar Artery is smaller than the external, and passes inwards behind the tendon of the tibialis anticus muscle to anastomose over the internal malleolus with the malleolar branches from the posterior tibial artery.

The Dorsalis Pedis Artery.—This vessel commences opposite the middle of the ankle-joint, as the direct continuation of the anterior tibial artery. It passes forwards and then turns downwards through the posterior end of the first intermetatarsal space, to terminate in the sole of the foot, by anastomosing with the external plantar artery to form the plantar arch.

Relations.—In this course the dorsalis pedis artery rests upon the astragalus, the scaphoid, and the middle cuneiform bones.

It is covered by the integuments and the deep fascia, and is crossed obliquely from without inwards by the innermost slip of the extensor brevis digitorum muscle.

To the inner side of the artery, though not in contact with it, is the tendon of the extensor proprius hallucis muscle.

To the outer side is the internal terminal branch of the anterior tibial nerve.

This artery, like the anterior tibial, is accompanied by two venæ comites.

Branches.—The branches of the dorsalis pedis are as follows:—

On the Dorsum of the Foot—

The tarsal artery.

The metatarsal artery.

The arteria dorsalis hallucis.

In the Sole of the Foot—

The arteria magna hallucis.

The Tarsal Artery usually arises opposite the head of the astragalus, from whence it passes outwards, covered by the

extensor brevis digitorum muscle, to the cuboid bone, where it terminates by anastomosing with the external malleolar artery from the anterior tibial, and with the peroneal, external plantar, and metatarsal arteries.

The Metatarsal Artery usually arises opposite the bases of the metatarsal bones, from whence it passes outwards covered by the short extensor of the toes, to the outer border of the foot.

This vessel gives off the *dorsal interosseous arteries* for the supply of the adjacent sides of the four outer toes. These vessels constitute the second, third, and fourth dorsal interosseous arteries, the first dorsal interosseous being the *arteria dorsalis hallucis* from the *dorsalis pedis* itself.

The fourth dorsal interosseous artery, in addition to supplying the adjacent sides of the fourth and fifth toes, usually gives off a small branch which supplies the outer side of the fifth toe.

The Arteria Dorsalis Hallucis, or the first dorsal interosseous artery, appears to be the continuation of the *dorsalis pedis* artery. It continues the line of that vessel forwards over the first dorsal interosseous muscle, in the first intermetatarsal space. It gives off a branch to the inner side of the great toe, and two collateral branches to the adjacent sides of the first and second toes.

The Arterial Supply of the Dorsal Surface of the Toes.

—The arterial supply to the dorsal surfaces of the toes is as follows:—

The first dorsal interosseous artery, or the *arteria dorsalis hallucis*, derived from the *dorsalis pedis* artery direct, supplies the one and a half inner toes.

The second, third, and fourth dorsal interosseous arteries, derived from the metatarsal branch of the *dorsalis pedis* artery, supply the remaining three and a half outer toes.

All the dorsal interosseous arteries communicate with the corresponding plantar vessels, by means of the anterior and posterior perforating arteries situated at the anterior and posterior ends respectively of the various intermetatarsal spaces.

The Anterior Peroneal Artery.—This vessel, one of the

two terminal branches of the peroneal artery, arises on the back of the leg. It reaches the front of the leg by passing forwards below the interosseous membrane, about one inch above the ankle-joint. It then runs downwards in front of the inferior tibio-fibular articulation to the dorsum and outer part of the foot, where it anastomoses with the external malleolar branches from the anterior tibial artery, and with the tarsal branches from the dorsalis pedis artery.

X. THE EXTERNAL OR PERONEAL REGION

Boundaries.—This region is bounded *in front* by the anterior peroneal septum, *behind* by the posterior peroneal septum, *externally* by the deep fascia of the leg, and *internally* by the external or peroneal surface of the shaft of the fibula.

Contents.—The true peroneal muscles—that is, the muscles which evert the foot—the peroneus longus and brevis muscles, and their nerve, the musculo-cutaneous nerve.

The Peroneus Longus Muscle.—This muscle extends from the upper and outer part of the leg, to the first metatarsal bone in the sole of the foot.

Origin.—From the external tuberosity of the tibia, and from the head and upper two-thirds of the external or peroneal surface of the shaft of the fibula.

From the anterior peroneal septum.

From the deep fascia of the leg.

From the posterior peroneal septum.

Insertion.—The tendon of insertion commences in the lower half of the leg, and passes downwards with the tendon of the peroneus brevis behind the external malleolus.

The tendon then inclines forwards on the outer side of the os calcis, below the peroneal tubercle, until it reaches the outer side of the cuboid bone, where it turns inwards into the sole of the foot, lying in the groove on the under surface of the cuboid; then crossing the sole of the foot obliquely from without inwards the peroneus longus tendon forms one of the structures in the fourth layer of muscles in the sole of the foot, and is finally inserted into the outer side of the base

of the first metatarsal bone, and the adjacent part of the internal cuneiform.

Nerve Supply.—The musculo-cutaneous nerve from the external popliteal.

Action.—The peroneus longus everts the foot at the transverse tarsal articulation, and secondarily extends the ankle.

Relations.—Immediately behind the external malleolus both the tendons of the peroneus longus and brevis pass under cover of the external annular ligament, lying in the same synovial compartment; but on the outer side of the os calcis each muscle has its own sheath, the two tendons and their sheaths being here separated by the peroneal tubercle; the peroneus brevis is above and the longus below that tubercle.

In the sole of the foot the tendon of the peroneus longus lies in the fourth layer of muscles of the sole of the foot, and is contained in an osseo-fibrous canal formed by the cuboid bone and the long plantar ligament, the tendon having here a second synovial sheath.

The external popliteal nerve terminates in the substance of the peroneus longus muscle, over the neck of the fibula, by dividing into its two terminal branches.

The Peroneus Brevis Muscle.—This muscle is much shorter than the longus, and extends from the middle of the outer side of the leg to the outer side of the foot.

Origin.—From the lower two-thirds of the external or peroneal surface of the shaft of the fibula, in front of the origin of the peroneus longus muscle; and from the anterior and posterior peroneal septa.

Insertion.—The tendon passes downwards behind the external malleolus, and then forwards on the outer surface of the os calcis above the peroneal tubercle, to be inserted into the tuberosity on the outer side of the base of the fifth metatarsal bone.

There is frequently an additional slip passing forwards to the anterior part of the fifth metatarsal, or to the dorsal extensor expansion. This slip, when present, constitutes the *peroneus quinti digiti*.

Nerve Supply.—The musculo-cutaneous nerve.

Action.—The peroneus brevis everts the foot at the transverse tarsal articulation, and secondarily extends the ankle.

The External Annular Ligament.—This ligament extends from the tip of the external malleolus to the outer side of the os calcis. It crosses the tendons of the peroneus longus and brevis.

The Musculo-Cutaneous Nerve.—This nerve commences over the neck of the fibula, in the substance of the peroneus longus, by the bifurcation of the external popliteal nerve into anterior tibial and musculo-cutaneous nerves.

The nerve then descends between the peronei muscles and the extensor longus digitorum to the lower third of the leg, where it pierces the deep fascia and becomes cutaneous. (See page 132.)

It supplies both the peroneus longus and brevis muscles.

XI. THE POSTERIOR TIBIO-FIBULAR OR FLEXOR REGION

Boundaries.—This region is bounded *in front* by the posterior peroneal septum, the postero-internal surface of the fibula, the interosseous membrane, and the posterior surface of the tibia; *posteriorly and at the sides*, by the deep fascia of the leg.

The space is subdivided into a superficial and a deep compartment by a process of deep fascia, which extends from the posterior peroneal septum to the deep fascia on the inner side of the leg.

Contents.—The *superficial compartment* contains the superficial flexor muscles, viz., the gastrocnemius, soleus, and plantaris muscles.

The *deep compartment* contains the deep flexor muscles, viz., the tibialis posticus, the flexor longus digitorum, the flexor longus hallucis, and the popliteus. It also contains the posterior tibial vessels and the posterior tibial nerve.

The External or Short Saphenous Vein.—This vein commences in the outer end of the dorsal venous plexus of the foot and passes upwards behind the external malleolus.

It then ascends along the outer side of the tendo Achillis and so gains the interval between the two heads of the gastrocnemius muscle. At the lower angle of the popliteal space it pierces the deep fascia and terminates in the popliteal vein. This vein is accompanied in its upper portion by the small sciatic nerve, and in its lower portion by the external or short saphenous nerve.

Cutaneous Nerves.—The cutaneous nerves on the back of the leg are numerous. They may be classified as follows:—

On the outer side of the leg—

The ramus communicans fibularis.

On the middle of the leg—

The small sciatic nerve.

The ramus communicans tibialis.

This nerve unites with the ramus communicans fibularis to form the external or short saphenous nerve.

On the inner side of the leg—

The internal cutaneous nerve from the anterior crural.

The internal or long saphenous nerve from the anterior crural.

The internal calcanean nerve from the posterior tibial nerve.

The Ramus Communicans Fibularis.—This nerve pierces the deep fascia very shortly after its origin from the external popliteal, and, descending behind the outer head of the gastrocnemius, joins the ramus communicans tibialis to form the external or short saphenous nerve.

The Small Sciatic Nerve.—This nerve becomes cutaneous by piercing the deep fascia just below the knee-joint. It accompanies the external or short saphenous vein as far as the middle of the back of the leg, where it terminates. It supplies the skin over the middle of the back of the calf.

The Ramus Communicans Tibialis.—This nerve, a branch of the internal popliteal, descends in the interval between the two heads of the gastrocnemius to about the middle of the back of the leg, where it pierces the deep fascia, and just

below that point it joins the ramus communicans fibularis to form the external or short saphenous nerve.

(a) The *external or short saphenous nerve* runs downwards, accompanying the external saphenous vein. It then turns along the outer side of the tendo Achillis forwards into the foot behind the external malleolus, and supplies the skin as far forwards as the outer side of the little toe. It also supplies the skin over the lower part of the back of the leg and the heel.

The Internal Cutaneous Nerve.—This nerve, by means of its anterior and posterior branches, supplies the skin over the upper part of the inner side of the leg.

The Internal or Long Saphenous Nerve.—This nerve gives off some cutaneous branches to the back of the leg. Its course has been already described. (See page 133.)

The Internal Calcanean Nerve.—This nerve is one of the two terminal branches of the calcaneo-plantar branch of the posterior tibial nerve. The nerve becomes cutaneous by piercing the internal annular ligament, and supplies the skin over the inner side of the heel.

The Internal Annular Ligament.—The internal annular ligament is a specially thickened portion of the deep fascia which extends from the internal malleolus to the os calcis. Its upper border is ill-defined, and is continuous with the deep fascia of the leg. Its lower border gives origin to the abductor hallucis muscle.

Between this ligament and the bones four distinct canals are formed, transmitting the following structures from within outwards:—

The *first canal* is situated next the internal malleolus, and transmits the tendon of the tibialis posticus.

The *second canal* transmits the tendon of the flexor longus digitorum.

The *third canal*, the broadest of the four canals, transmits the posterior tibial artery, its companion veins, and the posterior tibial nerve.

The *fourth canal* grooves the astragalus and the inferior surface of the sustentaculum tali of the os calcis, and transmits the tendon of the flexor longus hallucis. The three

canals which transmit tendons are all lined by a synovial membrane.

The Flexor Muscles on the Back of the Leg.—The flexor muscles on the back of the leg are seven in number, and are divided into two groups as follows:—

A superficial group, three in number—

The gastrocnemius muscle.

The plantaris muscle.

The soleus muscle.

A deep group, four in number—

The popliteus muscle.

The flexor longus digitorum muscle.

The flexor longus hallucis muscle.

The tibialis posticus muscle.

The Gastrocnemius Muscle.—The gastrocnemius muscle is a powerful muscle, forming the prominence of the calf, and extending from the femur to the os calcis.

Origin.—By two heads, outer and inner.

The *outer* head arises from the outer side of the external condyle of the femur, and also from the posterior surface of the femur just above the condyle.

The *inner* head arises from the upper part of the internal condyle of the femur just behind the adductor tubercle, and slightly from the lower end of the internal supracondylar ridge.

The Plantaris Muscle.—This small muscle arises from the femur just above the external condyle, and from the posterior ligament of the knee-joint. Its muscular part is only about three inches long, and it terminates in a long slender tendon, which, unlike any other tendon in the body, may be stretched out into an aponeurosis by the dissector.

The Soleus Muscle.—This large and powerful muscle is the deepest of the three superficial muscles of the calf.

Origin.—The *fibular head of origin* arises from the posterior surface of the head of the fibula and from the upper third of the posterior part of the postero-internal surface of the shaft of the same bone.

The *intermediate or aponeurotic head of origin* is from the process of deep fascia which arches over the posterior tibial

vessels and nerve, and which divides the posterior tibio-fibular region into a superficial and a deep compartment.

The *tibial head of origin* is from the oblique line, or the soleal ridge, and the internal border of the shaft of the tibia in its upper half.

The Tendo Achillis.—The tendo Achillis forms the common tendon of insertion of all three muscles. This tendon commences about the middle of the back of the leg, and is there about three inches wide. It becomes narrower as it descends, reaching its narrowest point about an inch and a half above the ankle-joint; it then again expands somewhat to its insertion, which is into the middle facet on the posterior surface of the os calcis, the tendon being separated from the upper facet by a bursa.

The tendon of the plantaris muscle does not always take part in the formation of the tendo Achillis; it by no means unusually has an entirely separate insertion, running along the inner side of the tendo Achillis to be inserted into the posterior surface of the os calcis, or even into the deep fascia.

Nerve Supply.—The three muscles which form the tendo Achillis are all supplied by the internal popliteal nerve, the soleus being supplied, in addition, by the posterior tibial nerve, so that the soleus has a double nerve supply.

Action.—All three muscles act together upon the ankle-joint, constituting a powerful and *primary* extensor of that joint. The gastrocnemius and plantaris muscles also act, in addition, as *secondary* flexors of the knee-joint. The action of these muscles upon the ankle-joint is typically exemplified in raising the body upwards on the toes.

The Posterior Tibial Artery.—This vessel commences opposite the lower border of the popliteus muscle by the bifurcation of the popliteal artery into anterior and posterior tibial arteries. Running down the back of the leg between the superficial and deep muscles of the calf, it terminates opposite the lower border of the internal annular ligament, at a point three-quarters of an inch behind and below the internal malleolus, by dividing into the internal and external

plantar arteries. The point of bifurcation may be indicated on the living subject by the mid-point of a line drawn from the internal malleolus to the centre of the convexity of the heel.

Relations.—*In front* of the artery, from above downwards, there are the tibialis posticus and flexor longus digitorum muscles, the tibia, and the ankle-joint.

Behind.—In the upper two-thirds of its extent the vessel is deeply situated, being covered by, or having behind it, the muscular portions of the gastrocnemius and soleus muscles.

In the lower third of its course it is quite superficial, and is only covered by the skin, the fascia, and near the ankle by the internal annular ligament. Its termination is covered by the origin of the abductor hallucis muscle.

Behind the internal malleolus the artery lies about midway between the malleolus and the tendo Achillis. To the inner side of the artery there are here the tendons of the tibialis posticus and flexor longus digitorum muscles, and one of the companion veins. To the outer side of the artery are the remaining companion vein, the posterior tibial nerve, and the tendon of the flexor longus hallucis. Commencing at the internal malleolus, and passing outwards to the heel, there are therefore, under cover of the internal annular ligament, the following structures:—

The tendon of the tibialis posticus.

The tendon of the flexor longus digitorum.

One of the venæ comites.

The posterior tibial artery.

One of the venæ comites.

The posterior tibial nerve.

The tendon of the flexor longus hallucis muscle.

Relation of the Posterior Tibial Nerve to the Artery.—The posterior tibial nerve crosses the artery from within outwards. It lies behind, or superficial to, the artery, crossing it just below the origin of the peroneal artery, that is, about one inch below the origin of the posterior tibial artery itself.

Branches.—The branches of the posterior tibial artery are as follows:—

Muscular branches.

Medullary or nutrient artery to the tibia.

The internal malleolar or internal calcanean branches.
Cutaneous branches.

A communicating branch to the peroneal artery.

The peroneal artery.

Muscular branches are given off to the deep group of muscles.

The Nutrient Artery to the Tibia arises from the posterior tibial artery near its origin. It is the largest artery of its kind in the body. It runs downwards from the knee, and pierces the tibialis posticus muscle to enter the tibia. Not infrequently this artery arises from the anterior tibial artery, before that vessel has passed to the front of the leg.

The Internal Malleolar or Internal Calcanean branches pass inwards, under cover of the tendons of the tibialis posticus and flexor longus digitorum muscles, to the internal malleolus, where they anastomose with the internal malleolar branches from the anterior tibial artery.

Cutaneous branches are given off in the lower third of the leg to the skin.

The communicating branch to the peroneal artery arises about one inch above the ankle-joint, and, being deeply situated, passes outwards under cover of the flexor longus hallucis to unite with a corresponding branch from the peroneal artery, thus forming an arterial arch between the two vessels.

The Peroneal Artery.—This artery, the largest branch given off by the posterior tibial, arises from that vessel, one inch below the lower border of the popliteus muscle. Running downwards, close to the fibula, it terminates opposite the lower end of the interosseous space, by dividing into its two terminal branches, anterior and posterior peroneal arteries.

In this course the peroneal artery runs at first outwards towards the fibula, between the soleus and the tibialis posticus, and then descends vertically along the shaft of the fibula, in a fibrous canal between the flexor longus hallucis and the tibialis posticus.

The artery is accompanied throughout by two companion veins, and the nerve to the flexor longus hallucis generally lies immediately behind the vessel.

Branches.—The branches of the peroneal artery are as follows:—

Muscular branches.

Medullary or nutrient artery to the fibula.

A communicating branch to the posterior tibial artery.

The two terminal branches, anterior and posterior peroneal.

Muscular branches are given off to the soleus, tibialis posticus, and flexor longus hallucis muscles.

The Medullary or Nutrient Artery to the Fibula runs downwards from the knee, and, piercing the tibialis posticus, enters the fibula near its middle.

A communicating branch unites with the similar artery from the posterior tibial, already described.

The Anterior Peroneal Artery, one of the two terminal branches of the peroneal, passes forwards below the interosseous membrane, about one inch above the ankle-joint, to gain the front of the leg, where its further course has already been described. (See page 141.)

The Posterior Peroneal Artery is continued downwards on the back of the leg, behind the inferior tibio-fibular articulation and the external malleolus, to the back and outer sides of the os calcis, where it anastomoses with the tarsal and external plantar arteries.

The Posterior Tibial Veins.—These commence on the inner side of the foot by the union of the plantar venæ comites. They accompany the artery throughout, and terminate opposite the lower border of the popliteus muscle, by uniting with the anterior tibial venæ comites, to form the popliteal vein.

The Posterior Tibial Nerve.—This nerve commences opposite the lower border of the popliteus as the direct continuation of the internal popliteal nerve. The nerve passes almost vertically down the leg, crossing the artery from above downwards and from within outwards, this being due to the fact that the artery inclines inwards, whilst the nerve passes almost directly downwards. The nerve crosses the artery about opposite the origin of the peroneal artery, that is, one inch below the lower border of the popliteus.

The nerve has the same relations as the artery, and terminates at the same place and in the same manner as the artery.

Branches.—The branches of the posterior tibial nerve may be classified as follows:—

Muscular branches.

To the tibialis posticus muscle.

To the flexor longus digitorum muscle.

To the flexor longus hallucis muscle.

To the soleus muscle.

Cutaneous branch.

The calcaneo-plantar nerve.

(a) Internal calcanean branches.

(b) Plantar cutaneous branches.

Articular filaments to the ankle-joint.

Terminal branches.

The internal plantar nerve.

The external plantar nerve.

The muscular branches arise from the upper part of the nerve either separately or by a common trunk.

The *Calcaneo-Plantar Nerve* arises in the lower part of the leg, and becomes superficial by piercing the internal annular ligament. It then divides into internal calcanean branches for the supply of the skin over the inner side of the heel, and plantar cutaneous branches for the supply of the skin over the inner and back part of the sole.

The Deep Muscles on the Back of the Leg.—These are four in number, as follows:—

The popliteus.

The flexor longus digitorum.

The flexor longus hallucis.

The tibialis posticus.

With the exception of the popliteus, all these muscles are supplied by the posterior tibial nerve. The popliteus is supplied by the internal popliteal nerve. It is, further, the only muscle of the group which acts solely on the knee-joint.

The Popliteus Muscle.—This is a triangular muscle situated at the back of the knee-joint.

Origin.—By a rounded tendon, from the depression at

the anterior part of the popliteal groove on the outer surface of the external condyle of the femur.

The whole of the popliteal groove is occupied by the tendon of origin of the muscle only when the knee-joint is fully flexed.

The tendon of origin lies within the external lateral and capsular ligaments of the knee-joint, and is in contact with the external semilunar fibro-cartilage of that joint.

Insertion.—The muscular fibres pass downwards and inwards, to be inserted into a triangular area on the posterior surface of the shaft of the tibia, above the oblique line or the soleal ridge, and also slightly into the aponeurosis covering the muscle.

Nerve Supply.—A long slender branch from the internal popliteal. The nerve to the popliteus passes down its posterior surface, hooks round the lower border of the muscle, and supplies it on its anterior or deep surface.

Action.—This muscle acts upon the knee-joint alone. Its principal action is inward rotation of the knee, but it also assists in flexing that joint. The muscle is especially used during the commencement of flexion of the knee-joint, as, without the inward rotation produced by the popliteus muscle, flexion of the knee cannot take place.

The Flexor Longus Digitorum Muscle.—This muscle passes from the innermost bone of the leg—the tibia—to the four outermost toes.

Origin.—From the middle two-fourths of the inner vertical portion of the posterior surface of the shaft of the tibia, extending as high upwards as the tibial head of origin of the soleus. It also arises from the fascia covering the tibialis posticus. The origin of the flexor longus digitorum lies to the inner side of the tibialis posticus.

Insertion.—The tendon passes through the second compartment of the internal annular ligament into the sole of the foot. (See page 159.)

Nerve Supply.—The posterior tibial nerve.

Action.—A *primary* flexor of the distal interphalangeal joints of the four outer toes, and a *secondary* extensor of the ankle-joint.

The Flexor Longus Hallucis Muscle.—This muscle passes from the outermost bone of the leg—the fibula—to the innermost toe, the hallux.

Origin.—From the lower two-thirds of the posterior part of the postero-internal or flexor surface of the shaft of the fibula.

From the posterior peroneal septum, and from the aponeurosis behind the tibialis posticus muscle.

Insertion.—The muscle passes through the outermost compartment of the internal annular ligament, and, grooving the back of the astragalus and the inferior surface of the sustentaculum tali of the os calcis, passes on into the sole of the foot. (See page 158.)

Nerve Supply.—The posterior tibial nerve.

Action.—A *primary* flexor of the interphalangeal joint of the hallux, and a *secondary* extensor of the ankle-joint.

Relations.—The tendon of the flexor longus hallucis lies successively in a groove on the lower end of the tibia, a groove on the back of the astragalus, and, lastly, in a groove on the inferior surface of the sustentaculum tali of the os calcis. It then enters the second layer of muscles of the foot, where its further course and insertion are described.

The Tibialis Posticus.—This muscle is deeply situated between the two bones of the leg, and extends from thence to the inner side of the foot.

Origin.—A *tibial head of origin*, from the upper half of the outer vertical portion of the posterior surface of the shaft of the tibia.

A *membranous origin*, from the posterior surface of the interosseous membrane, throughout nearly its whole extent.

A *fibular head of origin*, from the whole length of the internal portion of the postero-internal or flexor surface of the shaft of the fibula.

A *fascial origin*, from the deep fascia which covers the muscle and separates it from the flexors longus digitorum and longus hallucis muscles.

Insertion.—The tendon of insertion passes through the first or most internal compartment in the internal annular

ligament, into the foot, where it lies in the fourth layer of muscles of the sole of the foot.

It is inserted principally into the tubercle of the scaphoid bone, with secondary slips into all the other tarsal bones, except the astragalus, and all the metatarsals except the first and the fifth.

Nerve Supply.—The posterior tibial nerve.

Action.—This muscle acts *primarily* upon the transverse tarsal articulation, producing the movement of inversion of the foot. It also acts *secondarily* upon the ankle-joint, as an extensor. When standing, the tibialis posticus raises the foot in such a way that the subject will walk upon the outer edge of the foot.

Relations.—In the lower third of the leg the tendon of the tibialis posticus is crossed superficially, and from within outwards by the tendon of the flexor longus digitorum. After being so crossed, the tendon of the tibialis posticus lies in a groove on the back of the internal malleolus. It then enters the sole of the foot, and forms one of the structures in the fourth layer of muscles of the sole of the foot. It rests against the internal calcaneo-scaphoid ligament, which separates it from the head of the astragalus, and it is covered by the abductor hallucis muscle. The relation of the tendon of the tibialis posticus to the internal calcaneo-scaphoid ligament is very important in connection with the pathology and treatment of flat-foot.

XII. THE SOLE OF THE FOOT

The Superficial Fascia.—The superficial fascia on the sole of the foot contains much fat, which is more abundant in some places than in others; it is especially found in those places that are pressed upon in standing, such as the prominence of the heel, and over the heads of the metatarsal bones.

The fat is tough and granular, and is traversed by strong fibrous bands which divide it into small lobules and which connect the skin of the sole to the deep fascia.

The Deep Fascia, or the Plantar Fascia.—The deep

fascia of the sole of the foot, or the *plantar fascia*, is of considerable density and of great strength. Its thickness varies in different parts of the foot, and thus permits of its division into three parts—a central portion and two lateral portions. The differentiation between these three portions is marked off superficially by two superficial grooves, which also indicate the position from whence the intermuscular septa are sent upwards towards the tarsal bones.

(a) *The central portion* of the plantar fascia is the strongest of the three. It is narrow and pointed behind, where it is attached to the internal tubercle on the inferior surface of the os calcis. As it passes forwards it becomes broader and thinner, and, opposite the heads of the metatarsal bones, it subdivides into five digital slips, which pass forwards on to the toes. Each of these digital slips is connected with the digital sheaths of the flexor tendons of their respective toes, and also with the transverse metatarsal ligament.

In the intervals between the digital slips, the digital vessels and nerves and the lumbrical muscles make their appearance.

It rests upon and conceals from view the flexor brevis digitorum muscle.

(b) *The inner portion* of the plantar fascia is the thinnest of the three portions. It rests upon the abductor hallucis, which it conceals from view, and to which it gives origin in part.

(c) *The outer portion* of the plantar fascia appears as a strong band, passing from the external tubercle on the inferior surface of the os calcis to the tuberosity on the base of the fifth metatarsal. It covers the abductor minimi digiti, to which it gives origin in part.

(d) *The two intermuscular septa* pass upwards on either side of the flexor brevis digitorum muscle into the sole of the foot. They give origin in part to all three muscles in the first layer of the sole of the foot.

Muscles of the Sole of the Foot.—There are four layers of muscles in the sole of the foot. The first and third layers consist of short muscles. The second and fourth consist of

short muscles and of long tendons which enter the sole of the foot from other regions.

The muscles and tendons forming these various strata are enumerated in their respective places.

The Muscles of the First Layer.—The muscles of the first layer are as follows:—

The abductor hallucis muscle.

The flexor brevis digitorum muscle.

The abductor minimi digiti muscle.

Each one of these muscles has a fourfold origin.

The Abductor Hallucis Muscle.—*Origin.*—From the inner side of the internal tubercle of the os calcis.

From the internal annular ligament.

From the internal intermuscular septum.

From the internal portion of the plantar fascia covering the muscle.

Insertion.—Into the inner border of the base of the first phalanx of the great toe, in common with the insertion of the flexor brevis hallucis.

Nerve Supply.—The trunk of the internal plantar nerve.

Action.—The principal action of this muscle is not abduction, but flexion of the first metatarso-phalangeal joint. Its action as an abductor (on the same joint) is very slight.

The Flexor Brevis Digitorum Muscle.—*Origin.*—From the front of the internal tubercle of the os calcis.

From the deep surface of the central portion of the plantar fascia for about two inches.

From the internal intermuscular septum.

From the external intermuscular septum.

Insertion.—About the centre of the foot the muscle divides into four slender tendons, which pass forwards superficially to the tendons of the flexor longus digitorum muscle, and, entering the digital sheaths of the four outer toes, are inserted into the middle phalanges of these toes.

Each tendon splits over the first phalanx, in order to permit the tendons of the long flexor to pass through, and then, reuniting, each tendon again divides into two slips, which are inserted into the lateral margins of the second phalanges.

Nerve Supply.—The trunk of the internal plantar nerve.

Action.—A *primary* flexor of the first or proximal interphalangeal articulations, and a *secondary* flexor of the metatarso-phalangeal articulations.

The Abductor Minimi Digiti Muscle.—*Origin.*—From the front of the internal tubercle of the os calcis.

From the front of the external tubercle of the os calcis.

From the external intermuscular septum.

From the deep surface of the outer division of the plantar fascia.

Insertion.—Into the outer side of the base of the first phalanx of the little toe.

Nerve Supply.—The trunk of the external plantar nerve.

Action.—The principal action of this muscle is flexion of the fifth metatarso-phalangeal articulation. To a lesser extent it abducts that joint.

The Internal Plantar Artery.—This vessel commences at the lower border of the internal annular ligament, at a point three-quarters of an inch behind and below the internal malleolus, by the bifurcation of the posterior tibial artery into internal and external plantar arteries.

It is of very small size, and accompanies the internal plantar nerve under cover of the abductor hallucis muscle as far as the middle of the foot, where it terminates by breaking up into four small *superficial digital arteries* for the supply of the skin of the three and a half inner toes. The vessel also gives off cutaneous branches to the skin of the sole, muscular branches, and communicating branches to the digital arteries from the plantar arch.

The Second Layer of Muscles of the Sole of the Foot.

—The second layer consists of the following structures:—

The tendon of the flexor longus hallucis muscle.

The tendon of the flexor longus digitorum muscle.

The musculus accessorius muscle.

The four lumbrical muscles.

The Tendon of the Flexor Longus Hallucis Muscle.

This tendon enters the sole of the foot by grooving the posterior surface of the astragalus and the inferior surface of the sustentaculum tali of the os calcis. Passing forwards

and inwards, it is crossed superficially and from within outwards by the tendon of the flexor longus digitorum, to which it is frequently connected by a slip, after which it is inserted into the base of the terminal phalanx of the great toe.

The Tendon of the Flexor Longus Digitorum Muscle.

—This tendon crosses the tendon of the flexor longus hallucis superficially, and from within outwards, and then divides into four slips which pass forwards to be inserted into the terminal phalanges of the four outer toes.

Each one of these slips enters the sheath of its respective toe along with the corresponding tendon from the flexor brevis digitorum, which is pierced by the tendon from the long flexor opposite the first phalanx; both tendons are contained in a digital sheath precisely similar to that in the hand. (See page 62.)

The Musculus Accessorius.—*Origin.*—This muscle arises by two heads.

An *internal*, large, and muscular head from the inner surface of the os calcis.

An *outer*, pointed, and tendinous head from the outer surface of the os calcis a little in front of the external tubercle, and also from the long plantar ligament.

Insertion.—Into the external border of the tendon of the flexor longus digitorum muscle.

Nerve Supply.—The trunk of the external plantar nerve.

Action.—This muscle alters the line of traction of the long flexor of the toes, bringing the tendons of that muscle into the line of their respective digits.

The Four Lumbrical Muscles.—*Origin.*—The first lumbrical muscle arises from the tibial side of that tendon of the flexor longus digitorum which passes to the second toe. The outer three lumbricals arise from the adjacent sides of the tendons of the flexor longus digitorum between which they lie. These muscles decrease in size from within outwards.

Insertion.—Each lumbrical muscle passes round the tibial side of its respective digit, that is, round the tibial sides of the four outer toes, to the dorsal surface of the foot, where they are inserted into the dorsal extensor expansion.

Nerve Supply.—The first lumbrical is supplied by the second digital branch of the internal plantar nerve.

The three outer lumbricals are supplied by the deep division of the external plantar nerve.

Action.—The lumbrical muscles are *primary* flexors of the metatarso-phalangeal joints, and *secondary* extensors of the interphalangeal joints.

The Internal Plantar Nerve.—This nerve commences opposite the lower border of the internal annular ligament by the bifurcation of the posterior tibial nerve into internal and external plantar nerves. The internal plantar nerve is rather larger than the external plantar.

The internal plantar nerve passes forwards, at first covered by the abductor hallucis muscle, but afterwards in the interval between that muscle and the flexor brevis digitorum. It terminates by dividing into four digital branches for the supply of the skin of the three and a half inner toes.

The trunk of the internal plantar nerve supplies the abductor hallucis and the flexor brevis digitorum muscles. It also gives off cutaneous branches, and some articular filaments to the tarsal joints.

The first digital branch supplies the flexor brevis hallucis muscle, and the skin over the inner side of the great toe.

The second digital branch supplies the first or innermost lumbrical muscle, and then, dividing into two collateral branches, it supplies the skin over the adjacent sides of the first and second toes.

The third and fourth digital branches similarly divide into two collateral branches for the supply of the skin over the adjacent sides of the second and third, and third and fourth toes respectively. The fourth digital branch also communicates with the superficial division of the external plantar nerve.

The Muscles of the Third Layer.—The muscles of the third layer are as follows:—

The flexor brevis hallucis muscle.

The flexor brevis minimi digiti muscle.

The adductor obliquus hallucis muscle.

The adductor transversus hallucis muscle.

The Flexor Brevis Hallucis Muscle.—*Origin.*—This muscle arises by two heads—a flat tendinous head from the inner border of the cuboid bone, and a second head from the tendon of the tibialis posticus muscle.

Insertion.—The muscle is inserted by two tendinous slips into the inner and outer sides of the base of the first phalanx of the great toe, a sesamoid bone being present in each tendon of insertion.

Nerve Supply.—The first digital branch of the internal plantar nerve.

Action.—This muscle is a *primary* flexor of the first metatarso-phalangeal articulation.

The Flexor Brevis Minimi Digiti Muscle.—*Origin.*—This is a small muscle resembling one of the interosseous muscles. It arises from the base of the fifth metatarsal bone, and from the sheath of the peroneus longus muscle.

Insertion.—The muscle passes forwards to be inserted into the outer side of the base of the first phalanx of the fifth toe, in common with the abductor minimi digiti.

Nerve Supply.—The outer digital branch from the superficial division of the external plantar nerve.

Action.—A *primary* flexor of the fifth metatarso-phalangeal articulation.

The Adductor Obliquus Hallucis Muscle.—*Origin.*—From the tarsal extremities of the third and fourth metatarsal bones, and from the sheath of the peroneus longus muscle.

Insertion.—Into the outer side of the base of the first phalanx of the great toe, in common with the outer slip of insertion of the flexor brevis hallucis.

Nerve Supply.—The deep division of the external plantar nerve.

Action.—A *primary* adductor and *secondary* flexor of the first metatarso-phalangeal articulation.

The Adductor Transversus Hallucis Muscle.—*Origin.*—This muscle is situated transversely under cover of the flexor tendons, and arises from the inferior metatarso-phalangeal ligaments of the three outer toes.

Insertion.—Into the outer or fibular side of the first

phalanx of the great toe, in common with the adductor obliquus hallucis.

Nerve Supply.—The deep division of the external plantar nerve.

Action.—A *primary* adductor of the first metatarso-phalangeal articulation.

The External Plantar Artery and the Plantar Arch.—

The external plantar artery commences at the lower border of the internal annular ligament, by the bifurcation of the posterior tibial artery into internal and external plantars. It terminates by uniting with the dorsalis pedis artery in the sole of the foot, at the proximal end of the first intermetatarsal space, to form the plantar arch.

In this course the external plantar artery describes a curve with the concavity turned inwards, and so crosses the sole of the foot twice—first, from within outwards, towards the base of the fifth metatarsal bone; and, secondly, from without inwards, towards the proximal end of the first intermetatarsal space. It is the latter part of the vessel which forms the plantar arch.

(a) *In the first part of its course*, that is, from the inner side of the os calcis to the base of the fifth metatarsal bone, the external plantar artery is placed superficially. It rests upon the os calcis and the musculus accessorius, and is covered by the abductor hallucis and the flexor brevis digitorum muscles, and near the outer side of the foot it lies between the last-mentioned muscle and the abductor minimi digiti. It is accompanied throughout by two venæ comites and the external plantar nerve.

This part of the artery gives off muscular and cutaneous branches.

(b) *In the second part of its course* the external plantar artery is deeply situated between the third and fourth layers of muscles of the sole of the foot. It extends from the base of the fifth metatarsal to the proximal end of the first intermetatarsal space, where it is joined by the dorsalis pedis artery from the dorsum of the foot, and so completes the plantar arch.

The plantar arch, formed in the manner indicated, rests

upon the tarsal extremities of the metatarsals, and the interossei muscles. It is covered by the flexors of the toes, the lumbrical muscles, and the adductor obliquus hallucis. It is accompanied throughout by two venæ comites and by the deep division of the external plantar nerve.

Branches of the Plantar Arch.—These are as follows:—

The four digital arteries.

The three recurrent arteries.

The three posterior perforating arteries.

The Four Digital Arteries.—These vessels are numbered from without inwards; they are all deeply situated. The first digital supplies the outer side of the little toe; the second supplies the adjacent sides of the fourth and fifth toes; the third, the adjacent sides of the third and fourth toes; and the fourth, the adjacent sides of the second and third toes. At the point where the second, third, and fourth digital arteries bifurcate into their two collateral branches, they are connected to the dorsal interosseous arteries on the dorsum of the foot, by the *anterior perforating* arteries.

The digital arteries from the plantar arch thus supply the skin over the three and a half outer toes; the great toe and the inner side of the second toe are supplied by the *arteria magna hallucis*, a branch from the *dorsalis pedis* in the foot, to be presently described.

In addition to supplying the skin, the digital arteries also supply the muscles in the third and fourth layers in the sole of the foot.

The Three Recurrent Arteries.—These are three small vessels which pass backwards from the plantar arch to supply the tarsal articulations.

The Three Posterior Perforating Arteries.—These vessels pass upwards to the dorsum of the foot, through the proximal ends of the three outer intermetatarsal spaces, and between the heads of the dorsal interosseous muscles. Having reached the dorsum of the foot, they anastomose with the dorsal interosseous arteries from the metatarsal branch of the *dorsalis pedis* artery.

The Dorsalis Pedis Artery in the Sole of the Foot.—The *dorsalis pedis* artery enters the sole of the foot through

the proximal end of the first intermetatarsal space. Having given off the *arteria magna hallucis* for the supply of the inner one and a half toes, it immediately terminates by uniting with the external plantar artery to form the plantar arch. In this way, the last branch given off by the *dorsalis pedis* artery on the *dorsum* of the foot is the *arteria dorsalis hallucis*, for the supply of the one and a half inner toes; and the first branch given off by the vessel in the *sole* of the foot is the *arteria magna hallucis*, which similarly supplies the one and a half inner toes.

The External Plantar Nerve.—The external plantar nerve commences opposite the lower border of the internal annular ligament by the bifurcation of the posterior tibial nerve into internal and external plantar nerves. The external plantar nerve accompanies the first part of the external plantar artery to the outer side of the foot, and has the same relations as this part of the artery. At the outer side of the flexor brevis digitorum muscle, opposite the base of the fifth metatarsal bone, the nerve divides into a superficial and a deep division.

(a) *The superficial division* of the external plantar nerve passes forwards on the outer side of the foot, and gives off two digital branches for the supply of the skin over the outer one and a half toes.

The outermost digital branch is undivided, and supplies the skin on the outer side of the little toe. It also supplies the flexor brevis minimi digiti muscle, and occasionally the interosseous muscles in the fourth or outermost intermetatarsal space.

The innermost digital branch divides into two collateral branches for the supply of the skin on the adjacent sides of the fourth and fifth toes. This digital branch also communicates with the fourth or outermost digital branch from the internal plantar nerve.

(b) *The deep division* of the external plantar nerve accompanies the plantar arch and terminates in the adductor obliquus hallucis.

Branches of the External Plantar Nerve.—These may be classified as follows:—

The trunk of the external plantar nerve.

To the abductor minimi digiti.

To the musculus accessorius.

The superficial or cutaneous division.

Cutaneous branches to the one and a half outer toes.

Muscular branches to—

The flexor brevis minimi digiti muscle.

The outermost interossei muscles (occasionally).

The deep or muscular division.

To the adductor obliquus hallucis muscle.

To the adductor transversus hallucis muscle.

To the three outer lumbrical muscles.

To the interossei muscles.

The Muscles of the Fourth Layer.—The muscles of the fourth layer are as follows:—

The tendon of the peroneus longus muscle.

The tendon of the tibialis posticus muscle.

The dorsal interossei muscles.

The plantar interossei muscles.

The Tendon of the Peroneus Longus has already been described (*see* page 142). In the sole of the foot it lies in a sheath, which is formed for it by the long plantar ligament—a ligament belonging to the calcaneo-cuboid articulation, and which is prolonged to the tarsal extremities of the third, fourth, and fifth metatarsals. At the inner side of the foot the sheath of the peroneus longus is formed only by areolar tissue. This sheath is lined by synovial membrane. The tendon is inserted into the outer side of the base of the first metatarsal bone, and the adjacent part of the internal cuneiform.

The Tendon of the Tibialis Posticus.—Already described. (*See* page 154.)

The Dorsal Interosseous Muscles.—The dorsal interosseous muscles are four in number, one in each interosseous space. They abduct the toes from an imaginary line drawn through the centre of the longest digit—the second toe.

Origin.—Each dorsal interosseous muscle arises by two heads from the adjacent sides of the two metatarsals between which it lies.

Insertion.—If the action of the muscles is understood, then it is obvious that the *first* dorsal interosseous muscle must be inserted into the tibial side of the base of the first phalanx of the second toe, the *second* into the fibular side of the base of the same phalanx, the *third* into the fibular side of the base of the first phalanx of the third toe, and the *fourth* into the fibular side of the base of the first phalanx of the fourth toe. In addition to these osseous insertions, the dorsal interossei are also partially inserted into the dorsal extensor expansion, and so come to act secondarily upon the interphalangeal articulations, as well as on the metatarso-phalangeal articulations.

The Plantar Interosseous Muscles.—The plantar interosseous muscles are three in number. Each plantar interosseous muscle arises from the tibial side of its respective metatarsal—the third, fourth, or fifth—and is inserted into the tibial side of the base of the first phalanx of the same toe. The plantar interosseous muscles are also partially inserted into the dorsal extensor expansion; they will thus adduct the three outer metatarso-phalangeal articulations, and extend the interphalangeal articulations of the same toes.

Nerve Supply of the Interossei Muscles.—All the interossei are supplied by the deep or muscular division of the external plantar nerve. The interossei muscles in the outermost or fourth intermetatarsal space are occasionally supplied by the outermost digital branch from the superficial or cutaneous division of the external plantar nerve.

Action.—The dorsal interossei muscles are primarily abductors, and the plantar interossei primarily adductors of their respective digits, but, by means of their attachment to the dorsal extensor expansion, they also act as flexors of the metatarso-phalangeal articulations, and as extensors of the interphalangeal joints.

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